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Crop Production

ILLINOIS FARMERS' INSTITUTE CIRCULAR
NO. 3.

Lectures on Poultry Husbandry

AT THE

15th ANNUAL MEETING

HELD IN

Edwardsville, Illinois, February 22, 23 and 24, 1910.

(Reprint from Volume Fifteen, Illinois Farmers' Institute Report.)

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"THE STATE AND THE POULTRY MEN."

(Prof. James E. Rice, Professor of Poultry Husbandry, Cornell University,
Ithaca, New York.)

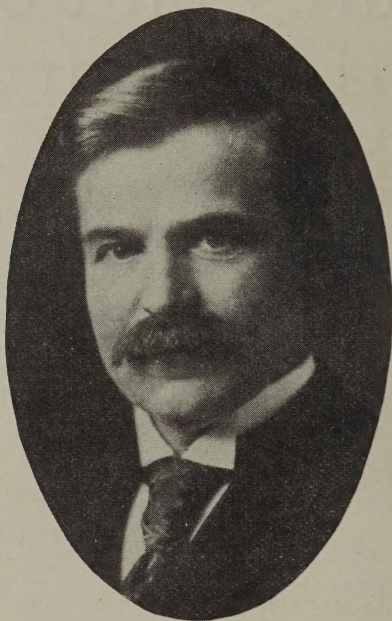
MR. PRESIDENT AND FARMERS OF ILLINOIS: I am free to say that Illinois is the biggest corn field I was ever in. I have just come from one end of the State to the other, and apparently I have not been out of a corn field a minute of the time. It would seem to me as though all the barns and the houses, and the manufacturing establishments, and the villages and cities were located in corn fields. I never knew before that I was born in a corn field, but I have the honor of having been born in Illinois. Consequently, I know now, although I was a little too young to appreciate it then, that I was born in a cornfield, and I am glad to get back to this, my native State.

It has been rather a surprise to me that the richest poultry state in the

Union should be one of the last to take up systematically the teaching and investigating in poultry husbandry. Illinois stands as the first state among all the richest states, agriculturally, and also as regards the value of the poultry and poultry products, according to the census of 1900, as you will see a little later in the lantern slides.

I have been asked to present, in the little time that we have available here, some of the chief reasons why poultry husbandry should be taught and investigated in the agricultural college and experimental station, and why poultry associations and every other educational organization in the State, the institutes, the fairs, and all the rest should be given State aid, as a good business investment. Money invested in any educational enterprise, provided it is properly and wisely expended, is perhaps the best paying investment that a state can possibly make.

Fundamentally, the chief reason why the State is justified in helping agriculture as a whole is that it is a basic industry, upon which all other occupations and professions primarily depend for their prosperity. Anything



PROF. JAMES E. RICE.

that will make a farmer prosperous will help to make all other people prosperous. This is particularly true of poultry, because poultry is an animal industry, and on this account is a long step in advance of grain farming, which means the sale of raw materials from the State, instead of increasing the animals within the State. This means a great deal when we come to look upon it broadly, in its ultimate influence upon the productivity of the land the prosperity of the farmer. Take for instance the poultry alone. You probably have in this State in the neighborhood of thirty million of hens; we have over twenty million in New York State.

Assuming that one-fifth, or thereabouts, of the actual money value of the feed of the hens will be left upon the farms, in the form of fertility, after the hens have taken their toll for their growth and their production, it would mean a saving in the State of Illinois alone of over six millions of dollars

annually, just in the keeping of the fertility here, as compared to sending the grain that you would have fed those hens, in other states, for somebody's use in manufacturing that raw material into the finished poultry products.

We need consider but a moment what better methods, by education and experimentation would mean to the prosperity of the farmers of the State. It will help us to know how, more economically and successfully, to build poultry houses, to feed poultry, to raise chickens, and to breed fowls. If by any or all of these means combined, we increase the production of the hens in the State one egg per hen, think what it would mean with thirty million of hens. Selling that egg at the average price of two cents will amount to over six hundred thousand dollars a year in the State of Illinois.

Increasing the value of a pound of the poultry meat one quarter of a cent and decreasing the cost of production of a pound of meat one quarter of a cent per pound, would mean two cents per fowl, and would have another six hundred thousand dollars added to the actual income of the poultrymen and farmers of the State of Illinois.

Now, are these things worth while? They are not beyond the range of possibility, in view of the actual results that have accrued upon hundreds and hundreds of farms in this State and in every other State, due to improved methods of feeding and handling of poultry.

Money spent in education in poultry husbandry is a good business investment. More than that, it is a State duty. A State that does not do these things for its poultrymen, is simply not living up to its obligation to the people, and the people can not keep up in the race of competition with the world when sister states are up to date and educating their poultrymen.

It makes all the difference in the world to you and to me and to the State whether we are putting a dollar into our pocket for something that we raised and sold, or whether we are pulling the dollars out of our pocket to send to a man in another state for something that he has raised and sold.

So long as a State does everything within its power to help its citizens, by better knowledge and better methods, to produce more economically and better quality, the standard of quality of live stock is raised and with it the standard of prosperity, until the people in other States are glad to send their money into this State to get the benefits of our improved breeding. Otherwise the breeders of this State would be sending their money into other states, paying it to the other fellow. We must face this situation. We must do in each state whatever may be necessary to develop the poultry interests along educational lines exactly the same as the others are doing. It is only fair and just to the poultrymen that this is done.

Poultry husbandry has an additional appeal to make. It is based on the fact that up to within a few years, only about five or six people were giving serious attention, serious thought, to the subject of teaching and investigating in poultry husbandry. For all these years since the Hatch Act, professors and scientific investigators have been helping to solve the problem of the dairyman, and of the fruit grower, and of the man engaged in every walk of agriculture except poultry.

Poultry has been left until the very last, and I presume naturally so. It is because the great mass of poultry is kept upon the farm as a mere incident, something that is merely a side issue. Although in the aggregate, poultry will closely approximate the value of the horticulture or the dairy interests in many of the States, and in some even surpassing them, yet taking it individually, poultry usually has amounted to only a little on any one particular farm. That is one of the reasons why it has not been given full consideration. Moreover, when you come to realize also that the poultry products of this country are worth five hundred million dollars, and when you consider that more people are directly interested in handling poultry than are interested in any other one agricultural industry, you will appreciate how it touches people from the human side.

Director Bailey of the New York State College of Agriculture, who was one of the very first to take serious recognition of Poultry Husbandry, says that with all due consideration for the commercial and financial advantages and other arguments, why poultry husbandry should be taught and investigated at the colleges and experiment stations, the one that appeals to him most is the fundamental argument that it is one of the best ways of reaching men and women as he describes it "in terms of their daily lives."

When you consult the experience of the states, few though they may be, where the colleges have been given an opportunity to teach and investigate, to publish bulletins, and to answer correspondence, you will find, I think, that without exception, the most enthusiastic have been surprised at the demand that has come from the people for poultry information. There is no kind of bulletin that is so quickly out of print at Cornell University or in Connecticut, or Rhode Island, or Maine, or any other state where the work has been given a fair opportunity to justify itself, than the poultry bulletin. They are out of print quicker than any other class. This shows the demand, as does also the correspondence, and how it is increasing.

Shall we, therefore, give the poultrymen the same opportunity as is given to other animal raisers, or shall we let them fight out for themselves their own salvation?

We are all one great nation wide family. Whatever is of benefit to one really in the end is a benefit to all. It is infinitely cheaper for a state to hire a few men who will devote their lives to the teaching and to the investigating of facts relating to poultry than it is for thousands upon thousands of poultrymen and farmers all over the State and the nation to go through the expensive, bitter experience of learning these things for themselves?

How much cheaper it is to have an experiment station, to hire a bacteriologist, a chemist, and a good poultryman, to work together in solving the cause and cure, of say, white diarrhea, than it is to let its devastations proceed in costly wastefulness.

Six states today have trained investigators working on that problem; they have found at least five or six different reasonable causes for the mortality in chickens.

Is it not cheaper for one state, like Maine, to spend a few thousand dollars, with trained people, to solve a law of production, through expensive trap nest experiments, and carefull bred pedigreed stock, than it is for hundreds of thousands of people all over the United States to try to find out that law for themselves, or go blindly facing the inevitable, year after year?

A state cannot make a better investment than to develop its poultry interests, and especially is this true of the State of Illinois, with its splendid crop producing power and extensive animal industries. Give the same proportionate attention to the poultry as she is now giving to other branches of agriculture, and the State of Illinois, when she finally wakes up to what she has been missing, and what she has failed to do in the past, is going to show the states that are already doing something for poultry, how it can be done in one of the richest and one of the best states in the Union.

I am very glad to be able to say that I know, from personal knowledge, that your splendid director and Dean, Dr. Davenport, is heartily in favor of this movement, and I am glad to chronicle that your poultry association—because I have had a good deal of correspondence with the officers—are thoroughly backing this movement.

When a movement to secure a Poultry Department for the Illinois State University is once started, probably nothing can stop it, and the Legislature will be as willing to promote the work as they have been in the State of New York. This last year, within the last four weeks, the Board of Trustees have recommended to the State Legislature, and the bill has been drawn and introduced, both in the Senate and Assembly, calling for ninety thousand dollars, to be put into a building for the department of poultry husbandry alone, and this to be followed later with twenty thousand dollars, at least, for additional buildings and equipment.

Now, friends, what I am saying about the demands of the people for a strong poultry department is not snap judgment. It is based purely upon seven years' experience. When the New York State Branch of American Poultry Association met last year, at Cornell, and investigated for themselves our needs, they recommended that fifty thousand dollars be asked of the legislature. When the Board of Trustees considered the question of an appropriation to poultry husbandry, they raised it to sixty thousand. Now that the bill has been introduced, it has been raised to ninety thousand. Just as sure as the sun shines, within three years—one year after that building is completed—every available spot in it will be in active use.

Six years ago we had twenty-seven students taking poultry. Registration has gone up, year after year, until last year we had 167 students taking poultry courses, notwithstanding the fact that all the courses in poultry husbandry are purely elective. This year we have been obliged to turn them away. For at least two years we have had people from the State of Illinois, and we have had them from nearly all the states of the union. I say these things not because it applies particularly to New York. The same statement can be made with regard to Rhode Island, Connecticut, Maine, and nearly every other state where they have given poultry husbandry a fair opportunity to justify itself.

The rest of the address will be given over to a rapid review of lantern slides with the particular object of showing you, first statistically and graphically, where poultry husbandry stands in relation to two great agricultural industries, dairying and horticulture, and secondly, to show you some of the poultry departments in the other states of the Union.

There are over thirty states now giving instruction, and carrying on investigation in poultry husbandry. This last year Illinois has fallen into line through the work of Professor Barto in teaching teachers poultry husbandry.

Now, if the lights will be turned off, the slides will run rapidly.

This table of figures shows you where Illinois stands:

Value of eggs produced in 1899:

Ohio	\$10,280,769	Iowa	\$10,016,707
Pennsylvania.....	9,080,725	Illinois.....	8,942,401
New York	8,630,062	Missouri.....	8,315,371
Indiana.....	7,441,944	Kansas.....	7,237,111

Comparison of eight best poultry states (value over three months old in 1900):

Iowa	\$6,535,464	Illinois.....	\$6,415,033
Missouri	5,720,359	Ohio	5,085,921
Pennsylvania.....	4,483,486	Kansas.....	4,376,197
New York	4,310,755	Indiana.....	4,222,409

Value of poultry and eggs produced in 1899:

Illinois.....	\$20,250,000	Iowa	\$19,508,526
Ohio	19,127,778	Missouri.....	17,840,623
Pennsylvania.....	16,231,968	Indiana.....	15,614,937
New York	14,791,491	Kansas.....	13,728,294

Value of poultry raised in 1899:

Illinois.....	\$11,307,599	Missouri.....	\$9,525,252
Iowa	9,491,819	Ohio	8,847,009
Indiana.....	8,172,993	Kansas.....	6,491,183
New York	6,161,429	Pennsylvania.....	7,151,243

You will see that the rating depends upon what value you place upon the poultry products and how you estimate them.

When you take the value of eggs produced in 1899, the order of the states is: Ohio, Iowa, Pennsylvania, Illinois, New York, Missouri, Indiana, Kansas. Value of eggs and poultry in 1899, it stands: Illinois, Iowa, Ohio, Missouri, Pennsylvania, Indiana, New York and Kansas. When you take the value of the poultry, including those over three months: Iowa, Illinois, Missouri, Ohio, Pennsylvania, Kansas, New York, Indiana. In just the value of the poultry raised in one year, 1899 it stands: Illinois, Missouri, Iowa, Ohio, Indiana, Kansas, New York, Pennsylvania.

Of these eight greatest poultry producing states, let us see what they are doing for poultry husbandry. The Ohio Experiment Station has just started, for the first time, a few coöperative experiments. The College at Columbus has started to give a short poultry course of a few weeks.

Iowa only three or four years ago established a poultry department with twenty acres of land and has a fair start in the matter of buildings, equipment, and a good man in charge.

Pennsylvania has started also and has been going for a few years, carrying on some experimental work and giving a short winter course, but it has not really gotten under way in a justifiable sense for so important a state.

Illinois has just started with Professor Barto in the teachers' work this last year.

New York, for about eighteen years, has been giving a few lectures at Cornell and carrying on some experimental work at Geneva and Ithaca, but only within recent years has the department been given an opportunity to justify itself.

Missouri has done nothing, so far as the college and experiment station is concerned, but has given an appropriation, which is a liberal one, to the State Poultry Board, for carrying on show work and the institute work, which is a very favorable indication.

Indiana this year, for the first time, has given ten thousand dollars, to be used at the rate of five thousand dollars each year. This is a mere pittance for so great a state, but they mean business.

Kansas has for a few years been working along this line, and now has a fairly good department under way, and are now producing good results.

What a showing is that, however, for eight great prosperous states?

Fig. 1 is a graphic representation of the amount of money that is given by each state to the agricultural college and experiment station, and the value of its poultry products as compared to each dollar invested in the college and experiment station for dairying, horticulture and poultry.

Proportionate value of dairy, horticultural and poultry products, compared to money expended by the seven largest poultry states, expressed in value of production to one dollar for instruction and investigation:

States.	Products.	Amount.
Illinois.....	Dairy.....	\$ 456
	Horticulture.....	435
	Poultry.....	20,500,000
Iowa.....	Dairy.....	236
	Horticulture.....	143
	Poultry.....	1,466
Kansas.....	Dairy.....	327
	Horticulture.....	45
	Poultry.....	1,017
Missouri.....	Dairy.....	418
	Horticulture.....	82
	Poultry.....	17,840,000
New York.....	Dairy.....	493
	Horticulture.....	1,354
	Poultry.....	753
Ohio.....	Dairy.....	1,011
	Horticulture.....	627
	Poultry.....	19,127,000
Pennsylvania.....	Dairy.....	335
	Horticulture.....	957
	Poultry.....	3,214

In other words, taking the State of Illinois, for instance, for every dollar expended in the college and experiment station for dairying, there are produced in the State \$450 worth of dairy products; for horticulture, \$435; but inasmuch as nothing was done for poultry, and the value of the poultry products was twenty million and over, therefore, poultry was contributing to the prosperity of the State and its actual production, twenty million dollars, and nothing being done to assist it.

In Iowa it was: For dairying, \$236, and horticulture, \$143. In poultry they were contributing at the ratio of \$1,466.

So you can follow down the line and you will see that in every one of these states poultry is actually giving, by way of production, to the prosperity of the State vastly more than is being given back, in the way of instruction and experimentation, so far as we may compare the other agricultural industries.

Fig. 2 shows the same thing, combined, from all of the states.

Proportional value of dairy, horticultural and poultry products compared to moneys expended by all the states reporting, expressed in value of production to one dollar expended for instruction and investigation:

	Land, stock, building and equipment.	Salaries and maintenance.	Total expenditure including permanent investment.
Dairy	\$ 523 00	\$1,771 00	\$ 404 00
Horticulture.....	402 00	1,151 00	319 00
Poultry	2,108 00	4,614 00	1,447 00

For instance, taking all the states into consideration, for every dollar expended in the college and experiment stations for the teaching and investigation of dairy products, \$523 are produced in value in these states, and in horticulture \$402, whereas for poultry it is \$2,108. It is shown graphically.

Average amount invested in poultry investigation as based on the states reporting:

1907

	No. stations reporting.	
Land	15	8.3 acres.
Stock	20	\$ 894 00
Buildings	22	2,690 00
Equipment.....	21	759 00
Total	26	5,129 00
Salary and maint.....	24	2,538 00
Total value.....	30	6,476 00
Products	53	5,305,335 00

1908

Land	22	9.5 acres.
Stock	27	\$ 894 00
Buildings	30	2,386 00
Equipment.....	26	586 00
Total	32	5,059 00
Salary and maint.....	27	2,785 00
Total value.....	32	6,231 00
Products	52	5,305,335 00

1909

	No. stations reporting.	
Land.....	28	8.4 acres, val. \$ 1,378 00
Stock.....	30	1,312 00
Buildings.....	29	4,354 00
Equipment.....	28	787 00
Total.....	30	7,543 00
Salary and maint.....	29	3,727 00
Total value.....	30	11,145 00
Products.....		

When you take the actual value of all combined, in salaries and maintenance, equipment, permanent investment and all, dairying is producing \$404, horticulture \$319, while poultry is producing \$1,477 for each dollar expended in the experiment stations and colleges.

Fig. 3 is another way of showing the same general statement, by statistics.

Summary of money invested in United States for instruction and investigation:

Dairy.....	\$6 00
Horticulture.....	7 00
Poultry.....	1 00

Summary of money expended annually in United States for instruction and investigation:

Dairy.....	\$4 00
Horticulture.....	4 00
Poultry.....	1 00

Proportionate value of products in United States:

Dairy.....	1.7
Horticulture.....	1.3
Poultry.....	1.0

We have, for every one dollar expended in the colleges and experiment stations for poultry, seven dollars expended for horticulture, and six dollars for the dairy, in permanent investments.

For salaries and maintenance, we have throughout the United States, for every dollar given in the experiment stations and colleges for poultry, four dollars for dairy, and four dollars for horticulture.

Now, taking the census of 1899, to find out the way in which these three great agricultural industries contribute to the wealth of the nation, we find that for every dollar that poultry contributes, horticulture contributes 1 3/10, while dairying contributes 1 7/10. Comparing poultry keeping with dairying and horticulture, in the proportion of what is produced, it is obvious that poultry is not given a fair recognition as compared with the other agricultural industries.

A few years ago the American Poultry Association appointed a committee to assemble these statistics from all over the United States and Canada. The following table shows the summaries of what they found up to the present time. The columns shown are the value of the land, stock, buildings, equipment, and the totals, then the salaries and maintenance, and the total of all, computed from the different states reporting.

Total agricultural college and experiment station poultry investments:

1907

	Number stations reporting.	Poultry Total.
Land.....	15	125 acres
Stock.....	20	\$ 17,895
Buildings.....	22	59,700
Equipment.....	21	15,937
Total.....	26	126,263
Salary and maint.....	24	60,928
Total.....	70	194,281

1908

	Number stations reporting.	Poultry total.	Per cent increase.
Land.....	22	178 $\frac{1}{2}$ acres	43.00
Stock.....	27	\$ 21,879	22.33
Buildings.....	30	71,602	20.90
Equipment.....	26	15,261	(4.00 decrease)
Total.....	32	140,199	11.40
Salary and maintenance.....	27	75,117	23.20
Total.....	42	198,027	1.90

1909

Land.....	28	277 acres (value \$38,585)	55
Stock.....	30	\$ 39,368	79
Buildings.....	29	126,283	76
Equipment.....	28	22,053	44
Total.....	30	226,289	60
Salary and maintenance.....	29	108,080	43
Total.....	30	334,369	68

The sets of columns show a comparison of the figures for 1907, 1908 and 1909. Large increases are shown in land, stock, buildings, equipment, persons employed, and in every other respect.

The value of stock in all the states of the Union, for poultry at the colleges and experiment stations for 1907 was \$17,000, and the next year \$21,000, this last year, 1909, \$39,000.

For buildings it was \$59,000, \$71,000, and now it is \$126,000.

For equipment it was \$15,000, about the same the second year and this year \$22,000.

For salaries and maintenance it was, in 1907, \$60,000, 1908, it was \$75,000 and now \$108,000.

Taking the totals three years it was \$194,000, then \$198,000, and now \$334,000, showing how the jump has been made in the last few years.

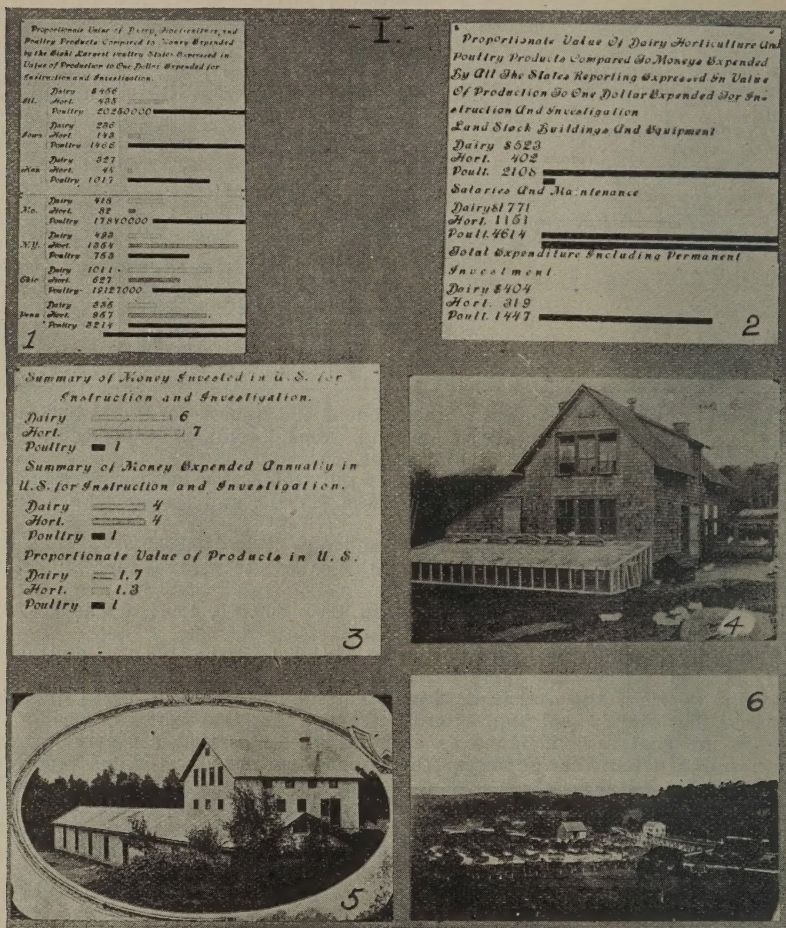
Again, we show the averages. I will not take the time to dwell on this in detail, but simply call your attention to the fact that when you come to average up what is being done by each of the states that are carrying on work, you will find that so far as the land is concerned, 28 states reported an average of 8.4 acres given over to poultry. So far as stock is concerned, the average value was \$1,300. For buildings, the average was \$4,300; for equipment \$787, and so on down, to the total value of the poultry department as a whole, which averages, in all the states that have departments, 30 in number, \$11,000.

(Average table, 1909, displayed as follows: by way of recapitulation):

	Number stations reporting.	
Land.....	28	8.4 acres, value \$ 1,378
Stock.....	30	1,312
Buildings.....	29	4,354
Equipment.....	28	787
Total.....	30	7,543
Salary and maintenance.....	29	3,727
Total value.....	30	11,145

We will now take a rapid review of some of the poultry departments of different states, with slides showing the buildings. This first slide is one showing the equipment at Rhode Island, one of the first states to start the

work. They established a poultry department and had the first poultry school in the year 1898. Since that time they have been giving a six weeks, or longer, course.



The first systematic attempt to teach poultry husbandry, however, was in New York at Cornell University, where in 1892, a course of ten poultry lectures was given to fifty students, and this was continued each year until the subject was recognized as a sub-department of animal husbandry in 1903.

Following directly after Rhode Island, Connecticut established a poultry school, and then a little later Maine, and then Utah and Kansas, and later Iowa and Michigan, and Maryland and so on, until at the present time we have thirty different states where the agricultural college or experiment station are doing something with poultry.

Fig. 4 shows the first building erected at the Rhode Island Experiment Station, where they devote all the space to the investigational work.

Rhode Island has carried on experiments in black head in turkeys for nine years, and think they have ascertained the cause. They find it is due to a bacteria or fungus that works on the liver, and is transmissible from one turkey to another. It apparently cannot be cured, but can be prevented by immunity of the stock in breeding, and by getting rid of the domestic fowl, not letting the hens and turkeys run together. The fowl apparently develops this disease in a weak form and it is not fatal, as a rule, while the turkey gets it from the hens and very quickly succumbs.

Fig. 5 shows the instructional building in Rhode Island, built with five thousand dollars appropriated especially for teaching work.

Fig. 6 shows part of the poultry plant of little Connecticut. They have been giving us a good example of what a little state can do in developing its poultry interests. This shows the main building, the barn, the main poultry house, and where they raise the chicks.



One of the valuable features in Connecticut is the summer work, in which they hold summer meetings of the poultry association which has representatives in every county in the State. They meet at different farms and have lectures and demonstrations. Four hundred or five hundred people sometimes assemble. One of their meetings is shown in Fig. 7.

Fig. 8 is the poultry plant at Guelph, Ontario. They have been giving us some of our very best results both in teaching and investigating for fifteen years or more. They probably have more money invested in several of their poultry departments in Canada than we have in the United States, so far as the principle stations are concerned. They have one at Quebec, and one at Guelph, and one at Ottawa. They have been doing some of the most practical work that has been done by any of the stations.

Fig. 9 shows one of the experiments at Guelph, Ontario. They have been working for ten or fifteen years, comparing poultry houses of different types. Their conclusion is that the cool house, the rather open fresh-air house, has given them, all things considered, their best results.

A good indication of what may be done in the experiment station, in the developing of good meat-type poultry is shown in Fig. 10. This is a picture I took at Guelph, of the best male and female. In eight years of systematic breeding for meat production, they have developed a strain of meat-type Barred Rocks. Any of you who are familiar with the meat type will see at once how it is modified to meet the conditions, in the broad breast with lots of meat on it, short joints and little waste parts, short thick neck and broad back. It is a superior meat type and has been a winner at many of the shows.

Question—How are those for layers?

Prof. Rice—Not as good as others. Whenever you increase to a high degree quick growth and the right type for meat, you have the general tendency that follows naturally, to decrease productivity; the same result that you would expect in the case of the beef cattle when compared to the dairy cow type as regards milk production.

Fig. 11 shows only one picture of the West Virginia experiment station, where they have published splendid results on the value of skim milk, comparative value of pure bred and mongrel stock, methods of running incubators, and feeding experiments of various kinds. They have given out several bulletins of great value.

I can only show one or two pictures of the West Virginia poultry department. This shows the range, where they rear the stock. They have also been giving us results on the comparative value of breeding from hens and pullets, in six different experiments, published a few months since.

Maine is more in the public eye, at present, probably than any other station and they have a right to be, because they have demonstrated the value of several exceedingly important methods in the modern handling of fowls. The curtain front house was proven feasible, after others, however, suggested it, and the hopper system of dry feeding was emphasized as was also the question of inheritance and the function of egg production.

The late Prof. Gowell was one of the first to bring out several progressive and valuable ideas. These have had great influence on our modern methods of building houses, breeding, feeding, etc. The poultry work in Maine illustrates the influence of the good work of one state upon all.

Fig. 12 is one of the large houses in which they keep their stock at the Maine experiment station.

Fig. 13 shows the Pennsylvania poultry buildings. They have one man and an assistant giving all their time to the poultry. Prof. Hunt pointed to twenty acres of beautiful land when I was there last and said, "Just as soon as we can get the right man educated to take care of this poultry department, he can have twenty acres of our best land on which to carry on the poultry work."

Fig. 14 shows one of the houses at the Kansas experiment station, where they have a college graduate in charge of their department who is doing a good work. He is making a special study of the market conditions of eggs and has recently written a valuable bulletin on the subject.

Fig. 15 is another poultry house at the Kansas experiment station. When these large, rich, middle west states once get under motion, we expect they will show us in the east how to do things.

Fig. 16 is the poultry plant at the Maryland State Experiment Station. A few years ago I had a letter from Prof. Patterson, who said he would be glad to start a poultry department, if he thought there was anything to investigate. He said his people felt there "wasn't anything they wanted to know." I pitied them to the bottom of my heart, and wrote several pages of experiments that ought to be investigated. He started his poultry department. It is now one of the most popular departments at the station and they are all very much pleased. They have a trained bacteriologist working on poultry diseases, and a practical poultry man looking after the plant.

Fig. 17 shows the Michigan poultry department, where they have a thoroughly trained man, devoting all his time with one or two assistants, carrying on the poultry work.



Prof. Dryden left Utah a few years ago where he had been doing excellent work, and went to Corvallis, Oregon. They have given him a splendid opportunity to show what can be done scientifically in helping poultrymen to solve problems in incubation. They gave him five thousand dollars for

buildings, equipment and apparatus, to investigate incubator problems. He has already given us some very valuable information and there is much more to follow.

Fig. 18 shows the interior and exterior of their incubator building.

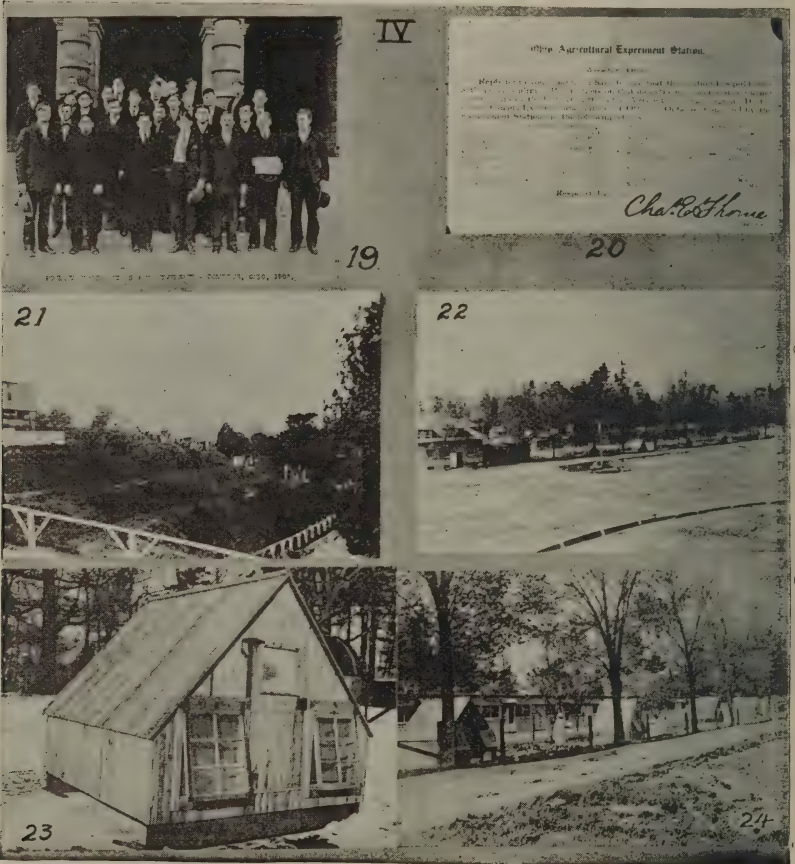


Fig. 19 shows a picture of the winter poultry course at the Ohio State University, when they first tried it two years ago. They are going to the Legislature this year for ten or fifteen thousand dollars for the poultry work and expect to get it. Please note that as a rule the poultry department is the last one to be established in a college. Consequently it is the one given least consideration until it makes good.

Fig. 20 shows what a director of one of our neighboring states did to help the poultrymen of his state, and he is one of our best directors. He apparently did not have the money; possibly he did not have the inclination to start poultry experiments. He certainly did not feel justified in establishing a poultry department, but he did do this much; he told his people where they could get the information. Inquiries evidently came in so rapidly to his station, asking where people could get poultry information, that instead of doing the work and finding out himself, he printed a postal card,

giving the names of all the states where people could write and get the information if they wanted it. (Laughter.) We are all glad to know that this director is now looking for a man to start the poultry work.

Down in Tennessee they did not want to take land that they could use for their cows or for any other purpose, so they took a side hill, too steep for cattle and gave it to the poultry department. It may be needless to say that this poultry venture did not succeed, not wholly due to the land however.

(Fig. 21.) The poultry department put in five or six terraces on the steep side-hill and put chicken houses on each terrace, and put a stairway leading up to the top floor. The chickens could run on that land and pasture on it, by using their wings if necessary. They did not dare to put the cows there, for fear they would get lopsided.

Three or four pictures follow of the Cornell poultry plant, which is very small. We only have four or five acres we can call our own. We are working on a very much congested and wholly improper plan. We are hoping for forty or fifty acres of land for a poultry farm. The director of the college and the president of the university have promised us a farm in the very near future.*

Fig. 22 shows the main building, and the long poultry house which the State gave us for teaching the students. The latter cost two thousand dollars and contains twenty-three pens.

Fig. 23 is a colony house, where the chickens are reared in flocks of 200 to 250.

Fig. 24 shows a closer view of where the chickens are raised. We call on the women to do the feeding of the young chickens.

Fig. 25 is another view of the Cornell plant, showing how it is congested, with little bare yards along the entire rear of the long poultry house.

Fig. 26 shows the house with cloth curtains in winter.

Question—Do these houses face the south so the sun will shine in?

Prof. Rice—Yes, all face the south.

One of the ways in which we try to reach the people of the State, is to have a card of which this is a front side (Fig. 27.). The children and others will get it and keep it because it contains a picture of chickens. It gives the address, so they will not forget where to write. On the other side is shown the ten ways in which we are trying to help the poultrymen. (Fig. 28.)

We will now have a brief review of the ways in which a poultry department can be of benefit to the people of the State.

First—By conducting experiments with poultry such as feeding, breeding, housing experiments, and the publishing of the bulletins. We expect, this year, to publish six bulletins relating to poultry.

A few years ago we were getting only three or four bulletins a year from different stations. This year we will probably have more than forty poultry bulletins published in the United States.

Second—By correspondence. The first year at Cornell we were getting in the neighborhood of 1,500 to 2,000 letters a year. Each year the number has increased until last year we had about eight thousand letters, and this year we will probably send out about ten thousand letters—entirely poultry correspondence.

Third—By special instruction in regular winter courses. We have, this year, about 154 students, taking some kind of poultry work. Fifty-five of these spent twelve weeks time with us and did nothing except to study poultry. We will see some of those study exercises a little later.

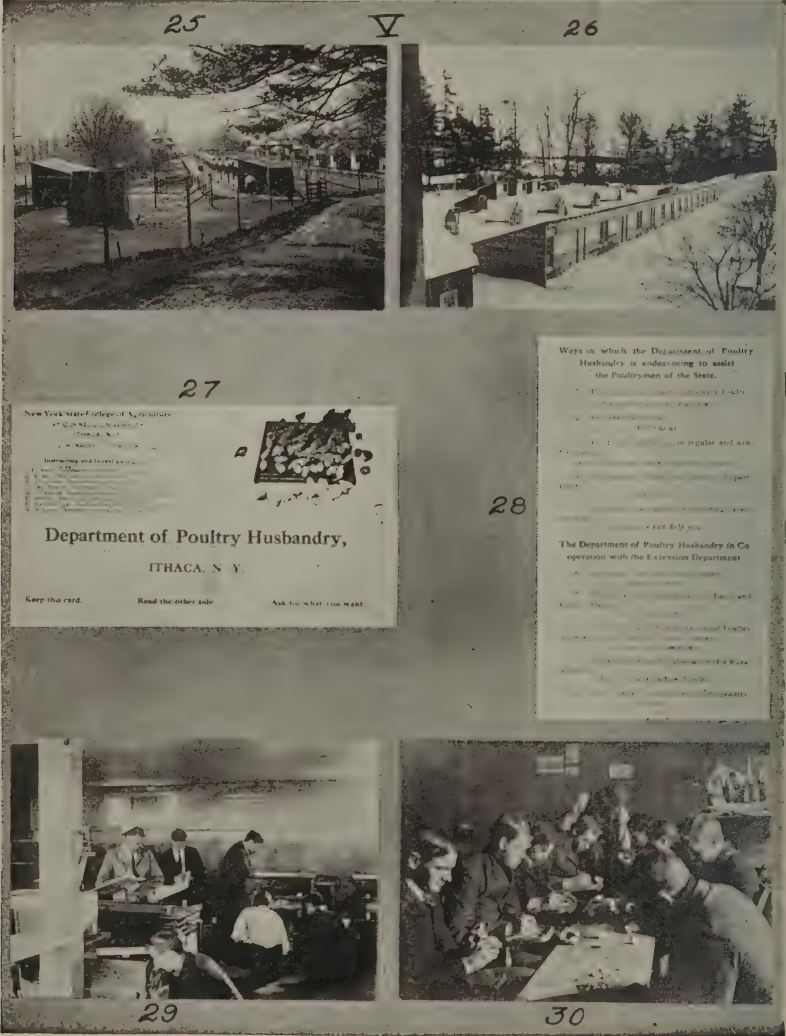
Fourth—By showing visitors the poultry department. You would be astonished to know how many people are interested in chickens, and who will come a long way to look at the experimental work, study the varieties and ask questions.

*NOTE—A fifty acre farm has been turned over to the poultry department since this lecture was delivered.

Fifth—By personal assistance in selecting breeding pens. We have several persons connected with our staff who, upon call, and dividing the expense with the breeder, will go out and select and mate up the pens in the spring of the year.

Sixth—By poultry reading course lessons. We have published eight of these on breeding, housing, raising chickens for market, and so forth, which the people of the State read, answer the questions and return with the correspondence.

The number of people who have taken these lessons will be indicated by the fact that large editions of 20,000 to 30,000 copies of each of the eight lessons have been practically exhausted.



Seventh—By educational exhibits at the fairs and poultry shows. Each year, for the last five or six years, we have had what we call educational exhibits, in connection with the poultry shows and fairs, in order that the people might see the results of the experiments in photographic form, or by charts and models and live chickens. We will see a little later one of those exhibits, and you can see for yourself what it means. Just to illustrate how effective this type of extension work is, in reaching the people, I will give you the facts. Take for instance, the Batavia County Fair. There we received the names and addresses of 770 people who wrote out an application for our poultry literature. At the State fair we received an even thousand names and addresses. At the Madison Square Garden poultry show, in the heart of New York City, where people had to pay fifty cents for admission, and therefore must be interested in poultry, they came to the exhibits and left their names to the extent of 1,463; and at the International Show at Buffalo, we capped the climax by having the names of 2,780 people most of whom apparently had never received poultry literature from the institution. We require them to make a written request, writing the name and address and leaving the card with us.

Eighth—We also aid the associations by giving lectures and demonstrations. A lecture or two is given each day, or during certain days to discuss methods of feeding, breeding, housing, etc. By this means a new clientage is brought to attend the show, and to get interested in pure bred poultry. Many of these people never would have attended a show, if it had not been for something on the program on the utility side. Once they are there, they learn to appreciate good poultry and become interested to the extent of purchasing it.

Ninth—By lessons in poultry husbandry in the rural schools. Our station is trying to get the boys and girls interested. We prepared a series of eight lessons. We are going to increase these until we have a full course, including a study of the eggs, feathers, combs, and breed types, etc., so that the boys and girls will by easy stages come to know good poultry when they see it, and how to take care of it.

Tenth—Coöperative experiments with poultry. The farmers keep the records of their fowls and give us the results.

Now for a very few slides, showing methods of teaching the subject of poultry husbandry. I can only show you comparatively few on account of lack of time.

Fig. 29 shows an incubator cellar. The students are doing the work of running the machines. We put through the incubator practice course this year something like ninety students who ran the machines and kept the records connected therewith.

Fig. 30 shows the "study of the egg" where the students will cut the eggs, which have been boiled, and name the parts and tell the function and use of each part, the shell, the membrane, etc. By this study they can understand what the hen is expected to do when she manufactures an egg.

Fig. 31 is a study of chick feeds. The student is expected to learn the composition and quality of about fifty feeds fed to poultry.

Here (Fig. 32) they are making egg crates for private family trade. We try to give the students as much experience as possible in working with their hands as well as their heads.

Here (Fig. 33) they are studying the anatomy of poultry, cutting up poultry to see what the digestive functions are, and naming the parts with a view to a better understanding of the feeding problem.

Every student has a pen with a flock of hens. He has to look after them for six weeks, keeping the records of the amount fed, the droppings, the time taken for doing the work, and the profit or loss.

Fig. 34 shows the students taking care of these fowls. Leghorns are generally regarded as being a little wild, but they can be tamed if handled properly. (Indicating).

In all our teaching, the principle is to try to have the student do the thing himself. No matter how much we may lecture, no matter how much we may teach from the books, the subject can never be rightly grasped until the student does the work. Otherwise we cannot expect good results.

(Fig. 35). Here they are making crates to ship the dressed poultry.

(Fig. 36.) Here they are washing hens for the poultry show. Every year, until this year, we have held a poultry show at Cornell. Now we have been obliged to give it up because we had no room in which to hold the show. If we get our new poultry building next year, we will resume that



very valuable feature of the work. The students are expected to select the fowl on their own judgment in the breeding pens, and to wash a fowl or more apiece.

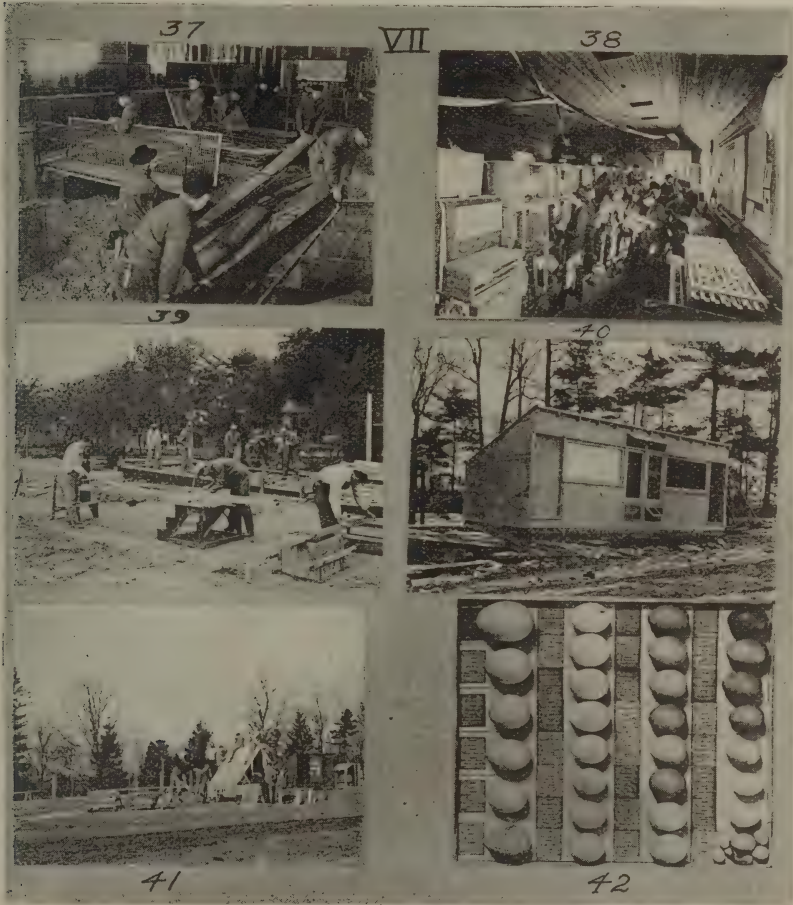
Question—Do you use anything in this wash to prevent nits and lice?

Prof. Rice—We make a louse powder at four cents a pound which serves the purpose of effectually killing the lice. It was invented by R. C. Lawry, an assistant in the poultry department at Cornell. The powder is made as follows: Mix one-fourth pint crude carbolic acid with three-fourths pint gasoline, stir this thoroughly into two and one-half pounds of plaster of paris, and sift through wire mosquito netting; then dry and dust through feathers.

(Fig. 37.) Here the boys are setting up the coops in the show. Each year they run the show themselves, do all the work, manage all the details, and exhibit the fowls. They then judge the fowls under competent instructors, so that when they get to their own homes they will understand how to organize a poultry show.

(Fig. 38.) Here they are judging the fowls for prizes which are offered for the student who makes the best records.

In Fig. 39 they are building a poultry house. Every year we try to build a new laying house, a colony house, or something of that kind, so the students can actually do the work, as well as observe how it is done from books and lectures.



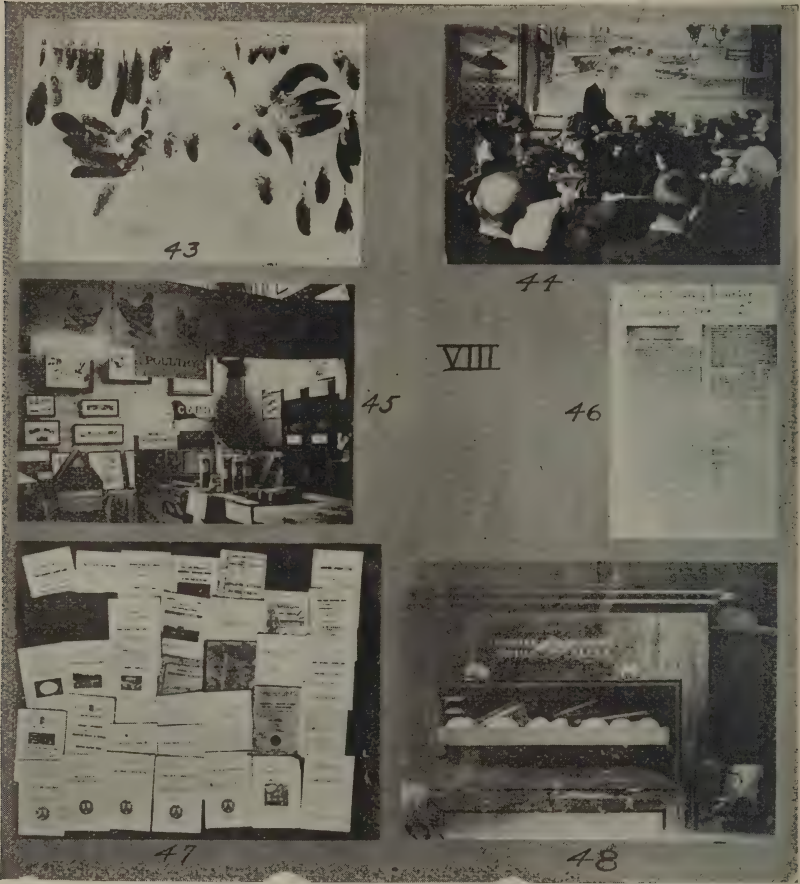
(Fig. 40.) Here they built a house, painted it, put in the stone foundation, and did everything from start to finish.

(Fig. 41.) Here they are building a colony house. I like this picture, because it is so characteristic. You can always count on the average American farm boy to be "onto his job."

(Fig. 42.) Here is a collection of eggs, of the different sizes, shapes and colors, with the names of the different breeds that laid them, to be used in the rural school work for the children.

(Fig. 43.) Here are shown the outlines of types of fowls, and the feathers, showing what part the feathers come from, so the children can learn these things for themselves in the rural schools.

(Fig. 44.) This show boys and girls learning public speaking. We have a course the students elect in the Extension Department. They go into the farming communities in the State with one of the instructors, to learn to speak to the farmers' audiences, giving the results of the poultry experiments carried out at the college.



(Fig. 45.) Here is one of the educational exhibits, a small corner only is shown, which shows the egg cases, charts, models, etc. People stop, look at this, and ask questions. They take with them a copy of the catalogue of the educational exhibit, which they can read later.

(Fig. 46.) This shows the first bulletin relating to poultry ever published in the United States. It was published in Maine in 1887. The experiment was carried on by Dr. W. H. Jordan, one of the first directors of an experiment station. He carried out an experiment, feeding wide and narrow rations to fowls. The result of that feeding experiment, carried on in 1885, and published in 1887, is correct in the light of modern experiments in the feeding of other domestic animals.

Last year we had thirty-six bulletins published in the United States and Canada instead of one in 1887. They are shown in Fig. 47.

(Fig. 48.) Here is an incubator with three thermometers; one is located with the bulb half way between the eggs, one upon the eggs, and one hanging just above the eggs. There is not more than an inch difference in height, less than that probably, between the lowest bulb and the highest one. You will see in the next slide (Fig. 49) what the difference is, in actual temper-



ature, reading as shown on the record sheet. We have carried on perhaps half a dozen tests of this sort, with essentially the same results. There is a wide difference, as you will see by the width of these lines. (Fig. 49.) One line running through the page as a medium line marks 103.06. The three fluted curves run below it or above it. The average temperature readings, as you can see, is five or six degrees difference, in the actual temperature reading shown on these three thermometers during the first week.

As the eggs warmed up and developed during the hatch, the temperature readings of the thermometers came together until nearly the end of the hatch, when they were right along side by side.

Let us see what the result was when you ran three incubators, one of them by a thermometer that was placed with the bulb above the eggs, one with the thermometer on the eggs, and one that was down between the eggs, and which in each instance were running 103 degrees. Now note the difference in the hatch (Fig. 50) and yet we followed the directions, running at 103 all through the hatch. The result was simply due to the difference in the way the thermometers were placed.

From fifty eggs we got three chicks where the thermometer was down between the eggs. From fifty eggs we got 23 chicks where the thermometer was on the eggs. From fifty eggs where the thermometer was above the eggs, we brought up thirty chicks. If we had run with either thermometer at a different temperature according to the height of the bulb, we could have secured better hatches, but we simply did not adjust our thermometer to the temperature. We ran them all on the same temperature, 103.06. From this experiment we learn that it is not safe to determine the temperature at which we shall run our incubator until we take into consideration the way the thermometer is placed and the type of machine to be used.

(Fig. 51.) This is a study in type. For three years different students have been working on a comparison of the anatomy of poultry and trying to find out what there is in type, and the waste in dressing, etc. This is only one study of many breeds. We are here comparing the White Leghorn with the Barred Plymouth. The same has been done with Wyandottes and Brahmas, and many others. The fowls are first photographed alive, then cut up into separate parts. The muscles are sliced first lengthwise and then horizontally, examined and photographed. The weights and measurements are all computed. One net result is that we found that if a person were buying 100 pounds of Plymouth Rock or Leghorn, he would get eight pounds more meat from 100 pounds of Plymouth Rock than from 100 pounds of Leghorn.

(Fig. 52.) There are chickens suffering from white diarrhea. It is probably due to a fungus or bacteria. There are six states now carrying on work to try to discover the cause. Thousands of dollars are lost in this country annually through this particular disease. With proper disinfection of incubator, brooder and yards, and rearing on clean ground with healthy stock, we feel that we have nothing to fear from this most troublesome disease.

I see that my time is up, so that as soon as the chairman returns I will have to discontinue the lecture at this point and give the rest of it this afternoon, when the meeting is held for the poultry section.

One of the experiments at Cornell was to compare four months of feeding pullets Fig. 53 shows the amount of feed the average fowl ate. There were eighty fowls in the experiment. We fed one lot on whole grain, wet mash and beef scrap; the next we fed on whole grain, dry mash and beef scrap; the next on whole grain and beef scrap without ground food; the next on whole grain, fed in a hopper, and beef scraps without ground feed. The net results of these experiments the first year was that the twenty hens that received the wet mash gave us a profit of \$21. Those that had the same material fed in a dry mash, where they could help themselves, was \$28. Those getting the whole grain, fed out of hand three times a day without ground feed, showed a profit of \$19. Those fed beef scrap and grain, getting it out of the hopper whenever they wanted it, gave a profit of only \$15.

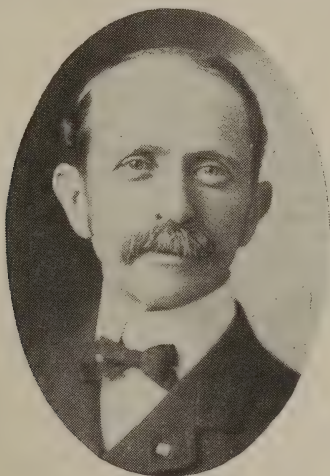
(Fig. 54.) In this slide is shown two colony houses in which we carried on experiments to determine the difference in temperature and humidity in similar houses, one having a glass window and the other a cloth window. We were surprised to find that the latter averaged less than two degrees colder than the former. It was also very much dryer and the air purer. The egg production and the health of the fowls was better in the house with the cloth windows during the three years' experiments.

This afternoon we will take up the moulting experiment, the grain experiment, the color feeding experiment, and the experiments of different ways of feeding chickens, and others that I had hoped to take up at this time.

I feel that I have crowded some of the speakers who are to follow on the program and so I will have to close my remarks for the present. I thank you for your attention.

POULTRY JUDGING AND BREEDING FROM A STANDPOINT OF GENERAL UTILITY.

MR. CHAIRMAN, LADIES AND GENTLEMEN—I wish to start off by reading a paragraph, from the American Poultry World, from an editorial: "When Secretary of Agriculture Wilson, in his opening address at Washington, (D.



D. T. HEIMLICH.

C.) September 1, 1908, stated that the poultry and egg products of the United States in 1908 amounted to \$700,000,000.00 and that only one crop exceeds it, and that was corn, it made some of the listeners do a lot of thinking. And it will make many more people stop to think before they can realize the immensity of the poultry business of the United States. The value of the poultry products of 1908 exceeds those of 1898 by over \$400,000,000.00, another remarkable feature in the growth of the hen as a national asset.

"And yet the poultry business is really just beginning to find itself, that is, modern methods of hatching, rearing and feeding, and marketing, are rapidly taking the place of the shiftless, slipshod methods of the past. Farmers are beginning to realize the value of producing choice poultry and eggs, and no longer look upon the hen as a vehicle for a little pin money for their wives, but are taking care of the poultry themselves. And still the supply of choice products of poultry and eggs fall short of the demand!"

The foregoing statement as made publicly at the nation's capitol by the Honorable James Wilson, Secretary of Agriculture of the United States, cannot again fail to direct wide-spread attention to the remarkable growth of the poultry industry during the last ten years, and to the high position it now holds in the list of products which each year add hundreds of millions of dollars to the national wealth. Secretary Wilson, with years of faithful and efficient service back of him, is recognized as being both conservative and reliable. His announcement, therefore, may well be accepted as official.

Some three or four years ago Secretary Wilson reported that the poultry and egg products of the United States for the year of 1905, reached a grand total of \$411,027,392.41. The census for 1900 gave the official total as \$280,686,429.00. It was expected that there would be a falling off in the value of poultry and egg products for the year 1908, because that year may be said to have represented "low tide" in the recent industrial and commercial affairs of the United States, on account of the panic of October 1907; but we are now assured by Secretary Wilson that despite the panic and general business depression the combined poultry and egg products for the year of 1908 amounted to \$700,000,000.00.

This is indeed good news. It has been claimed that during 1908 and 1909 there were fewer domestic fowls—chickens, turkeys, ducks and geese in the United States than during the prosperous years of 1905, 1906 and 1907, but it would appear that the reduced numbers, provided the general surmise on this point was correct, has been more than offset by the enhanced value of poultry and egg products during 1908.

The first week in January, following the holiday season, eggs for the table in New York City retailed at 70 cents per dozen. For two months past fresh eggs have retailed in Buffalo, N. Y., a city of secondary importance as a poultry and egg market, at 50 to 60 cents per dozen.

Dressed poultry has been proportionately high, turkeys in the eastern cities retailing during the holidays at 25 to 34 cents per pound. It was not many years ago in western cities of twenty-five to fifty thousand inhabitants, that a five or six pound chicken could be bought entire for 35 cents.

The high price of grain has had much to do with the advance in prices of poultry and eggs, but the demand also has increased, thus adding further to the upward trend in prices. There are no better human foods than poultry and eggs. Milk is the only rival of eggs for table use, and the prices of milk are also soaring these days. Seven and 8 cents per quart are now the prevailing prices in the large cities, whereas 5 cents per quart was the standard price for many years.

The advance in prices of poultry and eggs has kept pace with the increase in the prices of all kinds of meat—quite naturally. It is stated by men who should be in a position to know whereof they speak that the prices of farm products, also of meat, butter, eggs, etc., will never again go back to the old levels; that the increase in population, the increase in wealth per capita and the higher standards of living, not alone in this country but throughout the civilized world have been such that, taking into account the law of supply and demand, we must get used to paying higher prices for all the primary and secondary products of the farm, of the world's entire agricultural area.

It is evident that poultry raisers are getting used to the high prices now being charged for poultry foods. The renewed activity in all branches of the poultry business would seem to indicate this quite clearly. Certain it is that a brisk revival is taking place in the poultry business throughout the United States and Canada. This revival is keeping pace with the return of prosperity in other lines, if prosperity it may be called. President Taft has said that we are living "in an automobile age," meaning, in a broad sense, an extravagant age. No doubt this is true. It is plain that the standards of living are higher now than was the case one, two, five or a dozen decades ago, and this changed condition reaches from the top level of the social strata well down towards the very bottom. People now count as necessities of life many comforts that ten and twenty years ago either did not exist at all or were regarded as luxuries.

In our best judgment the near future looks bright for the poultry business. It can stand high prices of grain as well as any other meat producing industry. It is not a business that can be monopolized—a business for the ordinary farm, the village acre and the city lot. Every by-way and odd corner is being searched these days for low priced poultry foods, for more economical ways of producing poultry and eggs. This is as it should be. Not only is necessity the mother of invention, but the hope of reward has a stimulating effect.

We may well look forward with interest to the census returns for 1910 as regards the poultry and egg products of the United States. The census books are to close June 8, 1910, and if Secretary of Agriculture Wilson was correct in his speech at Washington, D. C., the week of December 7 to 11, 1909, to the effect that the poultry and egg products of 1908 amounted to seven hundred million dollars, what may we reasonably expect for 1910? Here is looking forward with confidence to a time well within the present decade when the United States will be able to boast of a billion dollar poultry industry.

In a slip I clipped from the paper the other day, during the present conditions, in commenting upon the existing situation, it was stated there were eleven million dozen of eggs in cold storage, more than in the previous year, regardless of the effect of the rise in price of grain and in the production of poultry being cut down.

Taking our Asiatic varieties; I do not wish to dwell long on this, only the principal subjects, as the time is limited. With some of our varieties, with the long necks, long legs and sloping backs, the chief claim made for them in their original state when first introduced to the American public was that they can eat corn off of a barrel. (Laughter).

These large specimens Light Brahams (indicating) have almost perfect forms. It is from this strain that many of our new varieties spring and have produced the Columbia Plymouth Rocks. We have here this morning the cross of the Columbia Plymouth Rocks that the second cross produces—clean legs, and character after the Plymouth Rocks. The specimen, while it is not at its best, shows what can be produced in a new variety when we aim to cross breed and have a definite type in view. New varieties are not objected to if the cross breeding is carried to the goal intended.

This new variety was introduced; (indicating), here we eliminate the pea comb of the Brahma, we eliminate the feather legs. Adopt the character of the Plymouth Rock and produce what we call the Beauty and Utility strain.

Now then, in the matter of production of eggs, this light Brahma hen, that is the grandmother of this chicken, (indicating) laid two hundred and forty-three eggs as a two year old; hence is named by Mrs. R. A. Judy (the originator) as Beauty and Utility Strain, Columbia Plymouth Rock.

There are 132 varieties of standard poultry. This will be one of the new varieties added to our list. It combines the beauty of the old Asiatics that helped to cultivate a taste for more artistic forms, more beautiful colors, and are well worth the attention of the poultry breeders who like contrast of colors.

Nothing has been taught in our schools that offers greater opportunity than the cultivation of poultry. We are only in the A. B. C.'s of this cultivation. Up to 1874 the government has not even kept a record of the poultry industry of the United States. Now we stand second from the forefront in farm husbandry. In the state of Missouri the poultry industry in that state exceeds twenty other farm productions. Calculating that three-fifths of the product is for home consumption, it would bring their total up to \$98,000,000, poultry raised, shipped, and also that consumed at home. That is Missouri. They have shown us.

We should, I believe, stand at the forefront. We have the greatest location and soil surroundings and conditions to produce more poultry than any other state in the Union. We are asking the people at the present time to help the movement onward. We are organizing every district in the State. There are meetings going on today. There are meetings again next week to organize, and in time, from every county we should have an organization that should join the State Association and then cooperate with the University. The State University should be the school where all shall have an opportunity to see and investigate the subject, throughout the fullest operations, and not mere glimpses, so to speak. There should be ten to twenty acres where every variety of the 132 should be shown, and be a center. It can be done so as to be practically self-supporting after a time, from eggs sold for setting, and stock, probably within two years.

That is one of the features that will come to us in the near future. The State Poultry Association is a good thing for every poultry producer in the State. Every man and women breeding a standard variety should belong to this organization.

In the new board we have a set of officers who have taken hold in the right way, and we are going to try to get not less than 2,000 members in this State. We are going to try to have a representative in each county, the superintendent of schools, any county official, or the mayor of a town, and to offer a prize for chickens to be represented from their county or congressional district. Governor Deneen has appointed a board of fifteen, each to represent a congressional district in the State. In other words, Illinois is beginning to wake up and endeavor to do something along the right lines. It will remain to be seen what we will accomplish.

If we have a representative in each county to agitate the matter, what will it mean? It will mean a set of officers who will go before the representatives in the legislature and ask for the things the farmers need, not only in their own localities but in other localities. It will be a general movement toward the up-lift of the poultry industry.

When we got our state appropriation years ago, we were met with this statement: "It is nonsense to ask for an appropriation; you don't want to use it in that way, you just want to get this money from the State." However, we obtained an appropriation. There is now one thousand dollars appropriated each year for the association.

Last year we wanted to get the people out and did not. Why? We had not advertised it. Now, however, we have had bulletins, and advertised, and circulated advertisements, so we are looking for greater things at our next meeting the first week in January 1911. This exhibit will be free to the public.

Take the subject of poultry talks in Illinois. I have heard of but three or four men who have been invited to speak on the subject at poultry exhibits. We must change this condition. We have got to do institute work. Those 152 men who carry licenses will have to wake up and do something besides taking their money and start for the next show with it. The next move will be to have poultry judges devote their time to poultry and the associations that employ them. The associations as a rule are willing to pay a good price for good men, but many don't want to take time to talk to the men and women, the boys and girls, and instruct them. How are we going to have such instruction disseminated?

We need a school where these young men who have natural ability, or ability they can cultivate, who have natural talents, a love for animals, who, in a word, "take" to this work, can become competent poultry judges. How are we going to get them? There is no provision made. We have to create a sentiment for that. These young men, the future poultry judges, must be educated in a practical and scientific work, as it should be done. It is not enough for a man here and there to dig out the information for himself, but provision should be made for the scientific study.

In the central west here, five or six judges got together. Then comes another along to dissarrange everything by ridicule. Now then, if a man has no faith in his own work, can he be competent to teach anybody? That is my position. It is that element that is too prevalent among the poultry judges.

There were fifty-six men appointed two years ago to lecture and talk on this subject. I have heard of Professor Rice and two or three others, who have spoken on the subject publicly.

I might read a lot of teachings on this subject, and the branches chosen by no two would be the same. It shows what can be done. It is that class of men we want to continue the work, and advance the progress of this aid to man's sustenance, so long overlooked, yet so important among the material things, by which, alone, we may, live, for the aims that make our lives worth while.

I am often asked, are there any large poultry plants making a success of poultry raising? Yes, and more every year. When I was in California last

November I met a gentleman who formerly was high in official life in Colorado. He was tired of public life and decided to move with his family to California and invest in White Leghorns. It was a peculiar country there. Those of you who have been to San Jose in Santa Clara county, California, know it is the greatest country in the world for fruit. Two years ago he had seven hundred and fifty Leghorns, and from each he realized over and above expenses two dollars per head. How did he do it? His business training was good and he had an account of every detail and the cost of everything; care and good management did it.

In another case a banker went to Colorado Springs eight years ago. He leased five acres and used two acres for poultry. He had nine hundred White Leghorns in the months of April, May and June. In 1905 he sold eleven hundred dollars' worth of eggs, most of them at regular market price.

What these men can do, others can do; not in the first year, but in two or three years. This same man adopted another plan since then. He keeps his pullets one year and sells them in the market. He does not keep a male on the place. He gets the eggs and is nothing out, only the feed, time, and attention to the stock.

Now this is a line of work that you or any one else can do and make a success. You can take anyone of these 132 varieties and, by careful selection, you can establish and maintain a flock that will pay you better and greater profits than anything you can invest in. There is money in the poultry business. We all know of the man who said he knew there was money in the poultry business, because he had put in five thousand dollars and never got a cent out of it. (Laughter.)

Question—What about crossing different kinds of standard poultry?

Answer—There is nothing to cross-breeding, because you are apt to reduce your grade in breeding unless you give it more attention, and continually use only high quality breeding and laying stock to keep up the flock to a high standard.

We don't want to look at a poor chicken or a poor animal of any kind, and improvement can only come by careful selection from the best produced. People breeding poor stock to standard stock, by that method reduce the higher breed of stock. There is a lot of skill required in the rearing of chickens and breeding of chickens.

Education for skill has a right to demand more time than a single day or week meeting. You must have that education for poultry raising.

It belongs in our high schools, every one of which should have a small pen of chickens to offer experiments to pupils. I think the high school can afford one, and teach the pupils a little about poultry culture. Take a boy or a girl who has interest in this and get him or her to come to the summer school at the University for six or eight weeks. Suppose we can only get three or four from each school in the State interested in this work, in which we are giving instructions; you will be surprised at the results in the community.

I think this meeting has done some good, and you will appreciate the interest taken. At the University, as I said yesterday, the poultry men themselves have not pushed it as they ought to. The University was, last year, a much larger school, and we are waiting for the people to take hold of it in the right way.

You can get much information in bulletin form. You have only to say "Please send us all the information relating to poultry raising." If you will write to different universities asking for the bulletins, you will get them and they will convey valuable information to you. The Rhode Island Station has made a specialty of that work. Any amount of information is in the bulletins, and they are for that purpose. They are public bulletins for you.

ILLINOIS AND THE POULTRY INTEREST—WHAT OUGHT TO BE DONE.

(Miss Kate Maxey, Curran, Illinois.)

MR. CHAIRMAN, LADIES AND GENTLEMEN—The topic which I am asked to discuss is one of great importance to the people of Illinois, who are in-

terested in poultry—and who are not—either as a producer or consumer. Formerly the “poultry crank,” as our admiring friends please to call us, was supposed to be engaged in a very little business. Now the poultry industry is the biggest little business on earth. It has come to the front, not by a slow and steady growth, but by leaps and bounds, and we are no longer pursued by the phantom that the business will be overdone. One of the most interesting facts is that one can begin to raise poultry on very small capital, with experience and equipment, and develop the business gradually, as the profits warrant.

Poultry yields larger profits for time and money invested than any other undertaking, and conditions were never so favorable for success in the business as now, to those who understand its management and give it full time and attention. The prediction of unheard of prices for this winter have certainly been fulfilled, in fact, they have been almost prohibitive for people of moderate means and large families.

The census of 1899 gives the total value of poultry products at that time as \$281,178,035. In 1909 Secretary Wilson credits poultry products with value of \$625,000,000. In ten years of time an increase of 222 per cent is shown. We are informed that the poultry business of this State last year was worth about \$40,000,000.

Illinois ranks second as to the value of her poultry products, only Iowa leading and Missouri being a dangerous rival.

While the production is increasing rapidly, that the demand is keeping pace with the supply is evidenced by the great increase in the prices of poultry and eggs. It is a fact that both poultry and eggs are imported to this country. In a country the size of ours, the conditions of which are such that the industry is capable of indefinite expansion, the poultry man and the farmer should certainly be able to supply the demand.

If any one doubts the importance of the poultry industry, let him study the question, observe the large business being done by railroad and express companies, the quantities of dressed poultry and eggs for sale in the markets, the manufacturies of paraphernalia incident to the poultry business. In addition to the sum actually realized from the sale of market poultry and eggs, there is an immense amount of money involved in other ways. It is estimated that the manufacturers of incubators and brooders do a two million dollar business annually. Large sums are spent for advertising for fancy breeding stock and high priced eggs for hatching. A large number of well attended shows are held each year at considerable expense.

There are about sixty poultry publications in the United States; nine of the best of these are published in Illinois with an aggregate circulation of 300,000, a larger circulation than the combined number published outside the State can boast.

The people of Illinois are among the most progressive poultry keepers in this country. All over the State are many farmers raising pure bred stocks, yet whenever any of our young people wish to make a special study of poultry work, they are compelled to seek instruction in some other state, perhaps crowding out students who have the first right there as natives of that state. Because of the practical work which is necessary, if the student really learns the poultry business, the number of students is often limited, as many states are more or less hampered by inadequate equipment and lack of funds.

There are now in the United States and Canada thirty-four states and provinces where some sort of investigation work is being done in poultry. There are sixty-five teaching poultry, and forty-two doing research work. Illinois stands almost alone in ignoring this branch of rural industry.

A splendid work has been done in some states, while others have just made a good beginning. In 1907 there were 879, in 1908, 1,369, and in 1909, 2,985, making a total of 6,102 persons taking some sort of poultry work. A few states have so far been able to provide for only a short winter course from

two to twelve weeks, where the course is designed not to turn out finished poultry men in so short a time, but to give a glimpse into the possibilities of the poultry business, to start a foundation upon which to build a successful career. These courses are practical and a great many subjects are taught and some experimental work is included, the amount depending upon the length of the course. It is a significant fact that the majority of states which give a two, three or four-year course also include the short course. Many who can afford neither the time or money for even a year's work can take advantage of the short courses, which are especially designed to help just such persons. Many colleges have complete courses where the student can specialize upon any part of the work he chooses.

Some of the subjects taught in a first class poultry department are: Principles of breeding, mating for exhibition utility purposes, natural and artificial incubation and brooding, general care, fattening and marketing, chemistry of food, foods and feeding, poultry building, location, construction and arrangement, furnishings, sanitation, diseases and parasites. Generally the instructors in the poultry department lecture at farmers' and poultry institutes over the State. They also carry on a large correspondence with poultry people in the State, and give desired information to those who visit the station. Graduates of these departments are in great demand as managers of poultry farms and to take charge of poultry departments and experiment stations. The supply is limited. In a few states specific appropriations are made to carry on the instruction and investigation at the State university. In others the poultry department shares in appropriations for the College of Agriculture.

One of the colleges which is doing very practical work for poultry is located at Guelph, Ontario. The question that Prof. Graham of that college has always before him is, "How can the farmers do better with poultry? How can they raise more and better poultry with increased profits?" It is the only college, I believe, where all who take the agricultural work must take the poultry work. The station is visited each year by 30,000 to 35,000 farmers. Ninety per cent of these farmers want to know about eggs and meat and only ten per cent are interested in fancy poultry. They have been raising chicks in corn fields and find they get better results at less cost than when grown on sod. They have experimented with crate fattened fowls and find that fifteen cents may be added to the market price of each fowl. They assert that an increase of one egg per hen in the province of Ontario would net \$200,000.00 annually, with eggs at twenty cents per dozen. This sum would more than support the agricultural college. Connecticut is asking for \$25,000 appropriation and expects no difficulty in getting it, as the poultry industry is very important in that state.

Michigan writes: "It is the aim in all our poultry courses to make them as practical as possible, so that the student who takes them will be familiar with the problems which he will meet when working for himself or on the poultry farm." They have sent out one or two bulletins among the farmers. Representatives of the college do judging work of poultry exhibits at fall fairs.

Wisconsin will spend \$6,000 for building this year and next.

Iowa has a well equipped farm of twenty acres. They hope soon to have a poultry lecturer who will give his whole time to work of that sort. They hope for a large appropriation next year.

Ohio has a bill now before the legislature asking for \$10,000 to establish a poultry plant at the university.

New York is asking the legislature for \$90,000 for a poultry building. Later they will need \$20,000 for equipment. They now have capacity for raising 5,000 chickens and wintering 1,500 head of poultry. Both gross and net income have steadily increased. The experiment station is doing splendid work which has to do with different phases of constitution and vigor. The office work and correspondence is very heavy. They have interesting plans for further work.

Maine published the first poultry bulletin in 1887, 180 to date. All agricultural students must take a stated amount of poultry work. The poultry department has a complete up-to-date equipment, equal to any institution of its kind in the country. The experimental department is largely under the control of the federal department.

Pennsylvania College of Agriculture conducts a school of correspondence in thirty-two subjects, one of which is poultry husbandry. A certificate is issued to all who pass satisfactory examinations and pay a small fee.

Indiana is just starting poultry work. They receive \$5,000 per annum.

Minnesota has \$5,000 for 1909 and \$2,500 for 1910-1911. They held a poultry institution in connection with the state show this year.

Massachusetts has been doing experimental work for fifteen years. The first poultry instruction will be given this year—a four weeks' course.

Missouri has no poultry course, but hopes to establish one within the next two years. They held a three weeks' course this year. The state recently received a \$10,000 appropriation, this money to be in charge of a State Poultry Board. The secretary of this board devotes his whole time to the work and is paid \$1,200 per annum. The Missouri State show held recently is said to have been the largest and best managed show held in the United States.

Colorado has \$5,000 with which to establish a poultry department, and is slowly making a start. They are doing effective work in institutes and short courses. They believe that Colorado possesses many advantages to poultry keepers, as they have unlimited market and are encouraging inquiries both in and out of the state to consider their advantages.

A few years ago the sum of \$25 was appropriated to start the poultry work at the Kansas college. The department has grown each year since. In February, 1908, a two years' laying contest was ended, in which were compared all the different varieties. The data as to cost and ways of feeding is valuable. The instruction has been given in a general way only, the main idea being to stimulate the raising of poultry as a side issue on the farm and to teach the students how to handle some of the simple problems of the business. The seniors study every phase of poultry husbandry, and are given practical work besides, just as far as the limited means will permit.

Rhode Island is doing valuable work in the study of diseases, especially of black head in turkeys. The records of the American Poultry Association tell us that for one dollar spent for instruction and investigation in poultry in the United States there are seven dollars spent in horticulture, and six dollars spent in dairy work.

From the government reports we find that the income from poultry, as compared with horticulture, as at the ratio of 10 to 13, while that between the poultry and dairy is 10 to 17. We find that for \$1.00 expended in Illinois for dairy work, \$456 is produced by the State; for horticulture, \$1.00 expended for instruction and experiment, \$435 produced by the State; for poultry no money expended for either, \$40,000,000 produced by the State. The legislature appropriates \$1,000 annually to the State Poultry Association. That Association is working for a 5,000 bird exhibit and for 5,000 people attendance for 1911. The plan for a State Poultry Board, one member from each congressional district to be appointed by the Governor, these members to look after the interest of the show in their own district. It is also proposed to have a poultry institute in connection with the next show.

SOME RESULTS OF RECENT INVESTIGATIONS IN POULTRY HUSBANDRY.

(By James E. Rice, Professor of Poultry Husbandry, New York State College of Agriculture at Cornell University, Ithaca, N. Y., before the Poultry Sectional Meeting of the Illinois Farmers' Institute at Edwardsville, Ill., February 24, 1910.)

FRIENDS AND FELLOW-POULTRYMEN—In the time which remains before I am obliged to catch my train it will be impossible for me to cover the field which

the importance of this subject ordinarily would demand. I will, therefore, show only the more important slides and make a brief statement explaining the nature of the problem and its direct application to our needs as poultrymen.

First, we will take up a consideration of some of the points in successful egg production. The first has to do with the physical condition of the fowl as influencing the production of eggs. It is necessary for us to study the condition of the hen as well as the composition of the ration. Experienced poultrymen have long known that the best feeders are close observers of the



way their fowls act and eat, which has led us to make some careful observations to learn the physical condition of the fowl best suited to egg production. What I shall say may surprise you, but I leave it with you to verify my observations for yourselves, and draw your own conclusions. It has become more and more apparent, as we have observed fowls when they have been doing their best laying, that they are heavy feeders and that they must have all they can eat, digest and assimilate if they are to continue to give us their best production. The old question therefore arises if we give hens all they want to eat of the right kind of food, will they not become too fat? Our

observations indicate that we have been inclined to place too much emphasis on the danger of fowls becoming too fat. This was especially emphasized a number of years ago when killing a very fat hen. We found this hen to be so exceedingly fat that she apparently was almost in a condition of fatty degeneration. The particular fowl in question is shown in figures 55 and 56 alive and dressed. When this fowl was opened she was found to be in perfect laying condition with an egg hard shelled and ready to be laid and any quantity of yolks in advanced stages of development. Since then I have seen many similar instances. On one occasion, when we were killing a large number of fowls, the fact that the hens that were found to be laying at the time they were killed were the fattest hens, led us to make a careful study of this question, with the result that we found that almost without exception the hens that were laying were the fattest and the hens that were not laying were the leanest. In fact, in no instances did we find that a lean hen was laying at the time she was killed. Figure 57 shows the three fattest hens and the three leanest hens side by side. Under each of these hens are placed the liver, gizzard and egg organs. In the three fattest hens eggs were fully formed with hard shells. In the three leanest hens the egg organs were dormant and under the most favorable conditions could not have laid for a number of weeks.

In Fig. 58 we are able to get a possible reason why hens have surplus fat in their bodies if they are to lay. It shows the egg organs of a fowl consisting of the ovary, where the yolk of the egg is developed, and the oviduct where the white is deposited, the shell membrane is laid on and the shell is made. The fact that the first part of the egg to be made is the yolk and that the yolk consists of more than half fat, would lead us to assume that the hen cannot make the first part of her egg unless she has surplus fat in her body. The fact that fat is energy and that only the hen that is in such physical condition that her bodily wants, so far as fat is concerned, have been supplied and she therefore, has surplus energy to store up against a time of need, would indicate that she is then in her best laying condition. Moreover, we have the best of evidence for believing that the fat in the yolk may be utilized by a fowl to supply the needs of the body, if, for any reason, should be withheld, so that she would have need for this material to supply heat and energy. In other words, that hens in full laying condition may cease to lay and have the fat in the yolk re-absorbed into the body if they become poor and need the fat.

We can get abundant verification of the reasonableness of the assumption that a hen in the best laying condition carries considerable surplus fat in her body in our observation of other domestic animals. It is a well-known principle in animal breeding that a condition of pregnancy is accompanied by a storing up of fat in order to meet the demands of nature in nourishing the offspring. In a very natural sense the hen, in her laying condition, may be compared to the pregnant mammal.

A more positive proof, however, that the best laying condition carries with it a condition of fatness, is found in the correlation in the weight of the fowl and her product. We have made a large number of observations in which we have found that fowls increase their consumption of food for a number of days before they begin to lay; that they increase their weight very soon after they increase the consumption of food and that they lay the best when they have reached their maximum weight; that they decline in weight as they decline in production. In other words, appetite is directly dependent upon production.

How we must feed our fowls in order that they may have surplus fat in their bodies to lay well without becoming too fat and break down with fatty degeneration, is an exceedingly difficult problem to solve. This is primarily true because fowls must be fed in flocks instead of individually. We must, therefore, take our chances on some fowls becoming too lazy and fat in order that the others may have enough food to meet their bodily requirements for the best production. This means careful grading of the flocks from time to

time to weed out the overfat hens though they may, at the time, be laying, and that we give all of the fowls, each day, all that they can possibly eat of the right kinds of food and at least once a day become hungry, as an



Strong **61** Weak
A. Barred Plymouth Rock



Strong **62** Weak
B. White Plymouth Rock

~ XI. ~



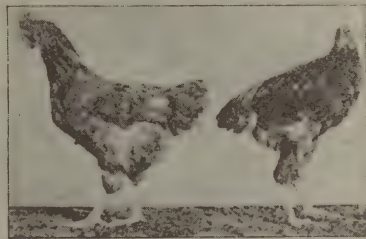
Weak **63** Strong
C. White Leghorn



Weak **64** Strong
D. Silver Spangled Hamburg



Weak **65** Strong
E. Buff Plymouth Rock



Strong **66** Weak
F. Buff Orpington

~~Figure~~—A, B, C, D, E and F. To show contrast in constitutional vigor in cockerels of six varieties.

indication that they have made good use of the food which has been given them. Plenty of exercise tends to keep the body strong and healthy. Hence, fowls should be encouraged to work as much as possible in a deep litter of

straw in the open air during the winter and have as wide a range as possible during the summer. As between the two dangers, it is better for us to take our chances on the fowls getting too fat, than it is in restricting the amount of food to keep them hungry to avoid overfatness. If fowls are active and are hungry once each day, the danger of overfatness is not great.

A problem which has caused considerable discussion among poultrymen and about which there is a good deal of difference of opinion at the present time, is in regard to the wisdom of undertaking to force fowls to molt earlier in the season than they ordinarily would be expected to do. In order to throw some light on this problem we carried out a series of experiments with six flocks of fowls aggregating about 240 individuals of different ages. In one experiment one-year-olds were used; in another two-year-olds and in another three-year-old fowls. All were White Leghorns. All were fed essentially the same rations and were kept, for the most part, under similar conditions. About one-half of the fowls of each of the three ages were fed during the entire year as well as possible for egg production without regard to the molt. The other half (about 120 fowls) were given restricted rations for about four weeks; that is to say, while they were fed the same kind of food as the other fowls in the experiment, the amount which was given was reduced for about four weeks to about one-third to one-half of the usual rations. By this means egg production almost ceased and the fowls averaged to lose about one-half a pound apiece in weight. After the starvation period they were fed liberally on the same rations and careful observations were taken each week of each fowl in order to determine the progress of the molt. For this purpose each of the six flocks of fowls was dipped in a different colored diamond dye. By this means the old feathers and the new could be distinguished. It was found that while the starvation process slightly hastened the molt, the fowls did not recover materially sooner from it and did not lay as well during the remainder of the year. It was found that the 120 hens that were starved paid a profit of 25 per cent less than those that were well fed during the molting season.

Figures 59 and 60 show the method of dipping the fowls in the diamond dyes and hen No. 61 in a molting condition. This hen was the best of all the trap nested hens in the experiment. She is alluded to here because of the fact that she molted so late. The molt did not occur until the 28th day of November, at which time this photograph was taken. She laid 213 eggs in the preceding nine months. Apparently the reason that she did not molt was because she continued to lay during the season when hens usually molt. A careful inspection of the records showed that, as a rule, the hens that molted latest were the best producers. This was simply because of the fact that they had an inherited tendency to lay, which postponed their molting period. If hen No. 61 had been in one of the flocks that were starved, she probably would have ceased to lay at that time and we would have failed to observe the principle that the best hens molted last. It is interesting to observe that in no instance did a hen continue to lay and molt at the same time. A number of hens began to molt before they ceased to lay and others might begin to lay before they completed their molt. As a rule, it took about 90 days from the time the fowl began to shed until she had grown all her new feathers.

The lesson which we gain from the above experiment would lead us to believe that it is wise for us to feed hens as well as we can during the entire year and especially to see that they are supplied, during the molting season, with an abundance of protein feed rich in nitrogen to grow feathers. At this time, particularly, meat, clover, oil meal, etc., should be fed. It leads us to the very practical conclusion also that it is mightily good business to let a hen lay when she wants to and not undertake to stop egg production and then taking our chances on starting it again later in the season when conditions are all unfavorable.

We are also led to save, rather than kill, the hens that molt last and who also show that they have good constitutional vigor. They are likely to be our best producers. Because they have continued to molt late is the best

evidence that they probably will rest for several months during the winter, which will make them all the more valuable for breeders during the following spring.

Without doubt the most important factor in successful poultry farming is to improve and to maintain strong constitutional vigor in a flock. The tendency of modern, intensive poultry farming has been to reduce the natural vitality of the race of the domestic fowl and to shorten its life. A large number of factors have contributed to this result. Among these are the close confinement of the fowl on limited areas during the summer and in small



close pens during the winter, together with heavy feeding on concentrated rich foods with the hope of stimulating egg production. In our endeavor to keep fowls comfortable during cold weather they have been so closely confined in vitiated, sultry air that they have suffered more from breathing impure air than they have suffered from the cold or frosted combs. The keeping of fowls in large flocks has frequently caused the attendant to overlook some that are weak, which because of their being jostled by the strong, have become weaker. These perhaps have survived until the breeding season when, as is the custom on many farms, there has been no careful selection

of the breeding stock. As a result eggs from this weak stock have been used for hatching because if they lay at all, it will be during the most favorable months of the year, March, April and May, when the hatching and rearing is done. In many instances sufficient care has not been taken to kill weak chickens at the time of hatching or later, which has, in some instances had a tendency to increase the mortality of the laying flock. Whatever the cause of low vitality, the fact remains that in many flocks fowls differ in their robustness and their ability to stand up under heavy feeding. This is true not only of certain strains or families, but of certain individuals within a common strain or family. So true is this that it is becoming more important to know the native vigor of the flock or of individuals within the flock, than to know the name of the variety.

It is, therefore, pertinent for us to inquire whether or not we can recognize constitutional vigor from weakness when we see it, either in a chicken or in a mature fowl. If so, how can we detect it and eliminate it from our flocks. We have been making a number of experiments at the Cornell Station to determine this point. We are perfectly certain that there are physical differences, which, if any one will study fowls of high and low vitality, they can quickly detect.

Figures 61, 62, 63, 64, 65, 66 and 67 show various types of fowls. They are both strong and weak types and show clearly, by their shape and attitude, their relative constitutional vigor. Generally, it may be said that a fowl that is of the narrow, slender body is of weaker vitality than a fowl of the same variety and age that has a short, thick, stocky body. The head should be short and broad with a well-curved, heavy beak, with large, bright-red appendage and with a clear, round, bright eye that stands out full and prominent. The drooping eyelid and dull sunken eye, the long, flat beak and crow head, the small, pale comb, indicate low vitality. The legs should be set wide apart in order to give body room to carry the digestive tract and to furnish the machinery for heavy digestion and large production. The lustre of the plumage, as well as the quantity of feathers and rapidity of feathering indicate constitutional vigor when the rule is applied to chickens of the same age and variety. A short, heavy shank is one of the most apparent features of a strong body and good digestion. The way the fowl crows and sings or cackles, depending upon the sex, indicates it has good health, as does also the way it eats. Fowls that get off the perches first in the morning and go to roost the last at night, generally have the strongest constitutions and are in the best laying condition, because their actions indicate that they are hungry and hence possess good health.

Selections should always be made of the breeding stock in the fall of the year, at which time only the best fowls of the strongest constitution are likely to be laying. It is found, also, that these fowls are the most prolific. A careful study of trap nested hens indicates that the poorest hens lay only during the most favorable season, while the best producers not only lay as well or better during this season, but they also lay during the unfavorable time of the year—the fall and winter. A person who will select his breeders on a basis of constitutional vigor during the fall and continue to eliminate will find it possible to increase the number of eggs laid per fowl and vastly reduce the mortality in the flock. Mere selection of constitutionally strong fowls, however, will not insure success. We must at the same time, eliminate the other conditions which tend to lower the vitality.

The following table gives the results of the first year experiments in comparing fowls of high and low vitality. It will be seen in the right hand column what the gain or loss is between the three strong flocks and the three weak flocks. Pens 78 and 79 compare high and low vitality chickens selected when young. Pens 76 and 75 were selected in the fall when placed in winter quarters. The same is true of pens 8 and 10.

FINANCIAL STATEMENT PER HEN BASIS.

										Difference.....
										Average, three flocks, weak—Pens 10, 75, 79..
										Average, three flocks, strong—Pens 8, 76, 78..
										Banded Plymouth Rock, fall, selection weak— Pen 10.....
										Banded Plymouth Rock, fall, selection strong— Pen 8.....
										White Leghorn, fall, se- lection weak—Pen 75..
										White Leghorn, fall, se- lection strong—Pen 76..
										White Leghorn, spring, selection weak—Pen 79
										White Leghorn, spring, selection strong—Pen 78.....
Number of eggs per hen	128.5	131.4	120.4	92.7	125.4	114.4	124.7	112.8	11.9	
Value eggs per hen	\$2.95	\$3.05	\$2.80	\$1.95	\$3.01	\$2.74	\$2.92	\$2.58	\$0.34	
Balance profit per hen	1.81	1.63	1.65	.74	1.71	1.57	1.72	1.32	.40	
Per cent mortality		16.87	3.17	31.52	12.54	8.34	6.9	18.91		
Per cent fertility	88.1	81.7	86.2	69.0	78.8	69.6	85.1	75.9	9.2	
Per cent hatching power	67.3	68.1	63.4	57.8	52.1	45.5	62.4	61.0	1.4	
Average weight in pounds, pullets saved	3.00	3.05	3.07	2.45	4.53	3.48	3.53	2.99	.54	

The fact that the importance of grit is not wholly appreciated is indicated in the results which we have secured in a number of experiments which we have tried in order to determine its value. Five separate experiments have been carried on along this line, the net results of which are that grit is necessary not only to furnish lime to make the egg shell, but also to serve as a grinding or crushing agent. Where fowls were fed on Mico Cubical Grit for eleven months, without oyster shells or bone or lime in any other form than in the grain rations which were fed, the hens ate practically all of their eggs from the very first ones that they laid as pullets. During this time they were in poor physical condition and apparently laid only a few eggs, which were inclined to be soft shelled. The total loss on these fowls during the eleven months of the experiment was over 70 cents per hen, without considering the labor. Six of these hens were removed at the close of the experiment and were fed, for several months, on the same kind of grit and same rations, with the exception that bone and oyster shell were given. As a result, the hens ceased to eat their eggs, improved in health and were in excellent laying condition when they were killed, as indicated in Figure 68. Figure 69 shows the hens eating eggs before they had been fed oyster shell. In another experiment one flock of hens was fed Mico Spar Cubical Grit and oyster shell while another flock of the same variety was fed the same materials in the form of a fine powder. In each instance, therefore, the fowls had a similar mineral supply but one flock had natural material and the other did not. There was a very decided gain in egg production in case of the flock that had the material with which to grind their feed, indicating very clearly that fowls need not only mineral matter but also some hard crushing agent with which to reduce the food in the gizzard.

Time will only permit one or two more slides. These will have to do with some experimental work which our Professor Rogers has been carrying on in the feeding of color pigments to determine changes which take place in the growth of fowls, and especially the development of the egg. Figure 70 shows the yolk of the egg that has been cut in two. You will notice the concentric rings of different colors, the yellow and red rings alternating. The fowl that laid this egg had been fed a red aniline dye every four days. This dye is known as Sudan III. It was brought to our attention by Dr. Oscar Riddle of Chicago University, who used it in some of his feeding experiments with hens. It has the peculiar quality of coloring the fat that a fowl suggests while this pigment is in the body, but does not color the fat that had been assimilated before the red pigment was fed. Hence, by feeding Sudan III at different intervals, one can tell by the red rings and the yellow rings of fat what has taken place in the time intervening between

the feedings. Figure 71 shows a chicken that was hatched from an egg that had been laid by a hen fed Sudan III. The pink colored fat in the body of the chick indicates that the colored fat of the yolk had been transmitted over into the body fat of the chicken. This gives us a fine illustration of the fact that a chicken may be born fat or lean, depending upon the material within the egg and the method of incubation, which enable the chicken to grow normally within the egg.

Figure 72 is the last slide. It shows a picture of the instructors and investigators in poultry husbandry in the United States and Canada who assembled two years ago at Ithaca, N. Y., and organized for more effective work. This will impress you with the fact that poultry husbandry, at last, is assuming the importance of a profession. It has always been a large and important industry. It is now becoming a systematized organized industry worthy of the thought and attention of thinking men and women.

With the hope that some of the points which I have endeavored to bring out in the short space of time which we have had for this lantern slide lecture will be sufficient to convince you of the importance of having a poultry department established in connection with your agricultural college and experiment station, where not only these but many other problems may be investigated, and with the wish and hope that you and other wide awake poultrymen in this great State of Illinois, will rise to the emergency and organize yourselves into a strong local association which may be welded together in a strong Illinois State Branch of the American Poultry Association so that you may work as a unit for the better development of poultry husbandry in the State, I bid you good-bye and hope to have the pleasure of some day meeting with you again.

IS THERE A PLACE FOR INSTRUCTION IN POULTRY HUSBANDRY IN THE PUBLIC SCHOOLS.

(Prof. D. O. Barto.)

MR. CHAIRMAN, LADIES AND GENTLEMEN: A problem that the College of Agriculture of our State University has been working upon for some time is to determine what work in agriculture is best suited to the conditions of public school teaching and can be made of greatest service to the communities where it is introduced.

Up to the present year the agricultural work that has been planned for the schools to undertake has dealt almost exclusively with studies of soils and crops. This is important and valuable work and many of our schools are now teaching these subjects very successfully and the university has recognized the educational value of these studies and offers credit for them as entrance preparatory work on the same basis as is given for any other school work.

But raising and feeding and breeding animals for food and clothing and other service is one of the most important fields of agriculture and certainly one in which there is as great need of the knowledge and use of the principles of science and of careful training in proper methods as is found in any line of agricultural work.

Moreover, animal life has especial interest and attraction for most young people, and presents so many sides for valuable scientific study and observation that there has seemed to be strong claims for adding courses in animal studies to the agricultural work in the public schools.

The principal obstacle that has stood in the way of doing this has been the difficulty of providing schools with proper material for the work and arranging for taking care of it both during the school year and the long vacation. In some communities it is possible to do considerable of this work, making use of the farm animals owned in the immediate vicinity, but even in the most favorable situations this has serious limitations. For satisfactory work in teaching and investigation the school needs to own and control its material, and this is obviously out of the question with most schools in the case of the larger farm animals, such as horses and cattle, or even with sheep and hogs.

However, it was my good fortune several years ago to become interested in raising and breeding poultry and that interest has remained and grown with me ever since. I had always cared for farm animals more than for any other kind of work, and my pleasantest boyhood associations on the farm are connected with handling and raising horses and sheep. When I took up the work of poultry culture I found there was quite as much opportunity for developing enthusiasm and scientific interest with this branch of animal industry as in the management of other kinds of stock and that there were some decided advantages in the work with chickens.

Poultry products are staple articles of food. Every house is directly interested in the quality and cost of these products. There is no other article of food that so many families may produce for themselves at their own home, and there is scarcely any other food produced whose value and quality so largely depend upon freshness, soundness and cleanliness of food used in producing it and healthfulness of the stock from which it is obtained.

For educational purposes poultry work possesses great advantages because it is work that is continuous throughout the year, presenting different



PROF. D. O. BARTO.

phases and problems with each season. It is also work in which results may be obtained in a few months' time and sufficiently large numbers may be handled to make experiments of some definite value. Moreover, none of the necessary work in connection with it is too difficult or too expensive for young people or women to undertake, and whatever experiments arouse interest in the school may be repeated in many homes of the pupils, thus giving greater meaning and usefulness to the work of the school by securing the sympathy and coöperation of the parents.

In the Academy, a department of the University in which several hundred boys and girls of high school grade are completing their preparation for entering colleges, last year, for the first time, courses in secondary school agriculture were given and this gave an opportunity to put the test to some theories as to what this work ought to be and how it could be best handled in these grades.

The introduction of a course in poultry was not considered until August, 1909, and no provision had been made for appropriating funds to purchase the material needed and maintain it during the year. However, a few hundred dollars were generally squeezed out of funds intended for the running

expenses of the Agricultural Extension Department and this sum enabled us to make a very modest beginning in work with poultry at the University of Illinois.

So much in explanation of why this work has been started and of the necessary limitations under which it has had to support itself and do its work this year.

First, we secured from the Agronomy Department of the Agricultural College the use of a strip of land sixteen rods long and four rods wide, lying just west of the Forestry. Fortunately my own residence was almost adjoining it, making it easy for me to give close supervision and to supply some things that were necessary in carrying on the work which our meagre funds would not allow us to buy this year.

Eight yards measuring two by four rods were fenced off and in each yard a portable house eight feet square was built. As we had no place for storing feed it was necessary to use one of these houses for that purpose, so only seven houses were available for housing poultry.

I wanted to stock these yards with first-class birds of several of the most popular and important breeds of chickens, but my funds would not allow me to offer prices that very high grade stock commands in the market. Two dollars a bird was my limit and that is what I paid for every chicken I bought.

However, I went to prominent breeders of pure-bred fowls and presented the case to them, asking them to be as generous and public-spirited as they could and saying that I believed it would be to their interests also to have representative birds of their breeding in the University poultry yards. Several of them saw it in that light and sent birds that would have sold undoubtedly to private purchasers for a higher price than I was able to offer for them, but in most of the yards the fowls are not of as high grade as we ought to keep for such purposes as we use them for and especially when they are in so conspicuous a place.

I hope it may be possible to secure for our pens next year breeding stock of better quality and more representative types.

The breeds used for the work this year are Barred Plymouth Rocks, White Wyandotts, Rhode Island Reds, Light Brahmas and White Leghorns. This selection gave us the three most important types of chickens, viz., the American or General Purpose, the Meat type and the Egg type.

The houses, though small in order to be portable as is desirable for high school use generally, were well built, modern and up-to-date in construction. They are of the style used by the poultry department at Cornell University for their colony houses and have proved very satisfactory this winter. They are all open-front houses and have demonstrated to those who have been watching the working of our little poultry plant that this feature of housing fowls is successful.

We have fed only dry feeds. A mixture of wheat, cracked corn and sprouted oats in about equal quantities is thrown into the litter morning and afternoon. Each hen receives a small handful at each feeding, about two ounces, and in addition a hopper hanging on the wall in each house is kept supplied with a dry mash of wheat bran, middlings, corn and oats, chop and beef scraps. The first three materials are mixed in equal quantities and about 10 per cent of the mixture is dried beef scrap put up by the packing houses.

Many people have shown much interest in the system of feeding because the results in the production of eggs have been good during every month from the beginning in October. Some of the hens have given better results than the others under the same treatment. Thus far the Rhode Island Reds and the Plymouth Rocks, both being pens of year-old hens, have shown finest results, and the White Leghorn pullets have kept in the rear. This does not necessarily show a superiority of one breed over the other, but is probably due to the fact that we were more fortunate in getting better laying strains from some breeds than for others. It is due to the Rhode Island Reds to say that they have won the admiration of every student and visitor who

has been watching their work not only by their uniformly good egg record, but also by the perfectness of the eggs and the appearance of vigor and hardness of every individual in the flock.

Because of the wide-spread interest in the claims made by the Philo System of keeping poultry and raising little chickens my students have been busy on Saturdays and holidays building Philo colony coops and brooder coops in order to test the merits of its new method of poultry culture by the side of the older-fashioned ways of doing the work. Our material is necessarily cheap and crude, the tools are few and simple and the workmanship rather unfinished in most cases, but there is an abundance of enthusiasm and faith in the importance of the work, and these are the factors of real value. The work is done in my furnace cellar where it is warm and we have electric lights.

The Reliable Incubator Company of Quincy, Ill., has generously presented us with a 200-egg-size incubator and a brooder for our use, and M. M. Johnson of Clay Center, Neb., has also sent us an Old Trusty incubator that has a capacity of 100 eggs. In addition the Prairie State Incubator Company make us an offer of a reduction of 50 per cent on their incubators and brooders which we shall probably avail ourselves of in order that we may have a fairly complete little equipment for our work in poultry in the Academy. The incubators will be installed in a room in my basement which will be fairly convenient for class purposes.

The sale of fresh eggs to University people and other neighbors at the highest market price (forty cents a dozen now) is bringing in a nice sum each month which pays for the feed and assistance and is making people appreciate the value of the poultry industry.

The work of raising and hatching little chicks will soon begin and the class will be busier than ever.

Nearly every poultry journal comes to our reading table and the pupils are gathering a large amount of poultry literature in bulletin form. Besides the students from the Academy there are a number of special students in agriculture from the Agricultural College who are taking the poultry work in the course.

I have made this a much longer story than I had planned. What I have wanted to do is to show that instruction in poultry is work well adapted to high school conditions, that it need not be difficult or expensive to handle and that it can be made very popular and interesting both with pupils and their parents. I believe every poultryman will see that it is a movement which he can and ought to help promote.

LARGE PROFIT IN POULTRY BUSINESS.

(Miss Kate Maxcy).

MR. CHAIRMAN, LADIES AND GENTLEMEN: I was a little afraid that there wouldn't be anything left for me to say but, will say some of the important things over again to make them more emphatic.

This is a topic in which I am greatly interested, although it is one that is not given the attention that it rightfully demands. It is a branch of work, however, when properly handled, I may say when it is intelligently handled, that will yield, from a view point of dollars and cents, larger returns than some other branches the farmer takes up and pays more attention to; in other words, I claim that the same amount of attention and intelligent effort expended in the poultry business will yield larger returns than many of those within my hearing have any conception of.

The value of the production each year runs away up in the millions.

There are many of the states that give short courses lasting from two to twelve weeks, and anyone that has the time to attend will find much to be learned there to their advantage. Also, there are complete courses. The instructors in these poultry departments do a good deal of circular work, sending out literature throughout the State. I don't know whether Prof. Rice touched on that or not, but the fact is that thousands of pamphlets each month are sent out, each taking up some important branch of this work, and

by filing these pamphlets as they are received from month to month, in a very short time you will have accumulated a very instructive poultry library, touching on almost every feature of the business and giving hints and suggestions that are invaluable to those engaged in that line of endeavor.

I understand that there is a movement on foot to increase the appropriation for this literature work, and heard the other day that Governor Deneen was much in favor of this and that it had his support, which is very encouraging to us.

One of the questions which has been the subject of many very eloquent addresses is "How to raise more and better poultry." That is a very broad subject and time prevents my going into it in detail. Much has been done in this country looking toward the raising of more poultry with the present facilities, and experimental work is being pushed forward every day how to raise better poultry. Canada has done valuable work in this line.

In Michigan it has been and is the aim to make all the courses just as practical as possible and get right down to the more important every day practices and apply them in such a way as to get the very best results in the most economical way before those in this line of endeavor.

Other states are taking a step forward in this industry. Ohio has a bill asking for \$10,000 to be appropriated for experimental work, and as Prof. Rice told you, we are waiting for the \$20,000 which this State will, I hope, appropriate.

Some of the other states are a little more up-to-date. Pennsylvania, for instance, has a correspondence course in poultry, which consists of nine lessons, and a small fee is charged, barely enough to defray the expense of carrying on the work.

Indiana has just received \$5,000 for this work; Massachusetts has just been enjoying an appropriation for the past fifteen years. Missouri as yet has no course in her university, but I understand that state also is to take a keener interest in poultry matters and I may add that although the university of that state does not go into this subject, yet the Missouri State Fair held this last year was said to be the best of any show held. Colorado has \$5,000 to support a department of poultry husbandry. They are doing very good work in Kansas. The data which we collected from that state is valuable. I am sorry to say that Rhode Island has not done very valuable work, but California, Idaho and Oregon have made great advances in the poultry affairs of their respective states.

The State of Illinois produced about \$40,000,000 worth of poultry in the last year and it does seem that an appropriation commensurate with the output should be allowed by the State Legislature for such work as we find it necessary to carry on. At our last State show there were nearly 5,000 people in attendance. It shows the great interest being taken in this work. There is a plan on foot for a State Board, to consist of one representative from each section, to handle the vast amount of business done.

In reply to the question "What ought to be done?" there is very little that can be done without the requisite money and the legislature ought to appropriate a sufficient sum to create a department of poultry husbandry. There should be a sufficient appropriation to encourage much more experimental work. A great many of the results reached are due to the efforts of other states. Will Illinois be able to do as much as some of the other states?

Of course it takes time to produce these results. We want now a department where our people can take up anything in the experimental work which seems necessary to the management of poultry farms, just like experimental work is done in matters of horticulture, bee-keeping and gardening. We want a department in charge of competent instructors to whom we can apply when we are in need of information on any particular point concerning which there is doubt. When our chickens are dying from some unknown cause, we ought to be able to call on some State department that has studied the various diseases pertaining to chickens, so that we can shut off this loss. Also, we want to know about the best and cheapest foods for poultry; we want to know the best way to handle poultry as a time saver, a saving of money and labor.

Poultry is one of the branches of agriculture and we should know more about it, and now let me impress upon you the thought that we should all of us earnestly strive to have an appropriation made by the State consistent with the magnitude of this branch of our work. We need an appropriation and we should take it up individually or through a committee which should be appointed to interest the law makers of the State in seeing that we get it.

Let us adopt the advertising plan and send letters to very legislator who doesn't know as much about poultry associations and poultry work as he ought to. Let us take a stand in this matter for the good of the department of the State University and let us be in doubt no longer. The appropriation will surely be effective of the best results.

The Chairman—I believe that this matter could be well treated in an educational way in Illinois and the appropriation that is sought will surely come. Do you realize what that great show in Springfield means, its far-reaching effect? What is the amount annually appropriated for that?

Prof. Heimlich—About \$2,000 a year for the State show.

The Chairman—There is a wonderful amount of money spent in the State of Illinois every year on this department and it is well spent.

There are bulletins issued from the State and also there are bulletins issued by the agricultural department at Washington and a postal card saying "Please send me all Farmers' bulletins relating to poultry raising" will bring you many instructive and valuable hints, suggestions, new methods of handling, proper care of poultry, comparisons of the experimental work done and in fact information of untold value to poultry raisers. Then if you write to the different universities you will get the benefit of the work done in the different states. Miss Maxcy has given you a few suggestions as to what some of the states are doing and in addition to those named by her I might suggest that Kentucky and Maryland have done much in this line. There is any amount of this information which is free for the asking. It is simply a matter of obtaining bulletins which are at your disposal.

Prof. Heimlich—I was spoken to by the chairman to say something of the present day of the State Poultry Association. You are all familiar with the present plans of the present association and if we successfully carry one-half our present hopes we will have succeeded beyond all the other states that I know anything about.

There is, among other of our plans, a movement to get a representative from every county, every district, and the privilege we accord each exhibitor, whether successful or not of finding out why his fowls didn't win or why they are more defective than others, so they may take advantage of that during the year ensuing so that by the next State exhibit they will have learned something and it will be an educational advantage to have everybody work in closer harmony. Education is what we must have. Our exhibits must be educational. Distribute throughout the country valuable information, let the people know what we have found by hard work, by the expenditure of money; on the other hand, we can learn from others what they have done. Much has been said about the appropriation. We should interest the law makers so as to get our appropriation. Education is what we want and I shall devote this summer to teaching right along the lines most practical, and I believe I can succeed, in a measure at least, in furthering the educational work in these matters.

Miss Maxcy—There was one thing I was going to speak about. They are planning this year to hold another show. Last year 200 members were there. I am referring now to the shows in smaller districts. Our own county is organizing and other counties are organizing. Make it county-wide and we will have it State wide.

Chairman—I will just add this word on what may be done in school. I had a letter from a little boy of 13 years of age: "A teacher of my school said that if I wrote to you for information you would write to me. Father has built me a \$300 concrete house for poultry and has helped me in buying three different breeds of fowls. I drive three and one-half miles to school and I do my poultry work during the morning hours. It will be because of the

help and encouragement that mother gives to me I am going to succeed in it. If you know of anything that will help me I should very much appreciate your sending it to me."

I want to thank every one of you for your kindness and patience during this meeting and hope you may greatly benefit from it. We all thank you very much. (Applause.)

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SPRINGFIELD, ILLINOIS:
ILLINOIS STATE JOURNAL CO., STATE PRINTERS
1911.

PRELIMINARY REPORT OF THE MORE IMPORTANT INSECTS OF THE TRUCK GARDENS OF ILLINOIS.

(By J. J. Davis, Assistant Entomologist for Northern Illinois.)

Introductory Note—The following paper on the more important insects of the truck-farm and vegetable garden was prepared by Mr. John J. Davis while he was in the service of the State Entomologist's office as assistant for northern Illinois. It was planned as an article for the Entomologist's report, but is published in the report of the State Farmers' Institute as a means of giving it earlier and wider circulation among those most immediately interested in its contents. Besides the main results of Mr. Davis' work on this subject for three and a half years, while stationed at Chicago, it contains an abstract of the contents of published papers on its topic.

STEPHEN A. FORBES, *State Entomologist.*

Vegetable gardening is now one of the most important of the various agricultural interests of Illinois. According to the census of 1900 there were 256,213 acres in vegetables in Illinois in 1899, and the value of the products amounted to \$10,346,797.00, this being the fourth largest valuation of such products for all the states. The average valuation of vegetables was \$42.00 per acre, while that of all crops taken together was but \$10.04. Although the gardening industry in Illinois, and especially in Cook county and counties adjoining, has greatly increased since 1899, the figures for that year serve to indicate the relatively great importance of vegetable-growing in Illinois.

Chicago is the principal center of the truck-garden industry of this State; and for a distance of 12 to 18 miles north, south and west of the city, agriculture is almost wholly gardening. This area is especially well adapted to such farming, as the more or less sandy character of the soil permits early tillage—a very important fact from the truck gardener's point of view, since it enables him to get his products on the market at an early date, while prices are still high. Cook county growers have a market close at hand so that they can personally dispose of their produce, making sales from their own wagons, thus avoiding freight and commission charges. Further, Chicago affords an ample supply of manure for continuous fertilization, which is absolutely necessary where such intensive farming is practiced, and where so much is taken from the soil each year.

Another important consideration is the labor supply; for such crops as onions and cucumbers require large numbers of laborers at certain times of the year, and in isolated localities and in small towns there is usually insufficient help in the busiest parts of the season. In Cook county, however, the city of Chicago can usually furnish all the labor required, and at a cheaper rate than in remote localities.

Probably the most important garden product of Illinois is the potato. The area in this crop in Illinois in 1899 was 139,464 acres, and the estimated value of the product was \$4,702,033.00. In Cook county alone there were 15,336 acres in potatoes. Onions and cabbage are important crops, as are also asparagus, celery, beets, and that class of vegetables known as general truck, which includes radishes, lettuce, parsnips, carrots, rhubarb, beans, etc. The growing of sweet corn, tomatoes, beans and peas for canning, and of cucumbers for pickling, is becoming a prominent industry, and the same is true of melon-growing in many parts of the State. Cucumbers, tomatoes, lettuce and radishes are extensively grown in hothouses, as well as out-of-doors.

The gardening regions are more or less divided into areas in each of which a certain class of products is cultivated. For example, a strip of ground half a mile or a mile in width may be used for onion culture almost exclusively, or it may be in potatoes or cabbage, or both, or it may be devoted to general gardening.

The more intensive the culture of a crop, the more important becomes the control of its insect enemies. Land is especially desirable for vegetable gardens near the market centers, and as these are almost invariably large cities, such land has a high value, and the greatest possible returns must be realized from it. To insure this the control of injurious insects becomes of great, if not prime, importance.

General Farm Methods for Control of Insects.

Clean Culture—Probably the most valuable of all farm practices for the control of insects is clean culture, by which is meant the clearing away of all useless vegetation, and the numerous other general measures which leave for insects no sufficient winter shelter, or adequate protection from the weather, the birds, and other natural checks upon their numbers. In fall, rubbish of every kind, and especially standing unmarketable cabbages and onions, should be collected and destroyed, to deprive insects of their breeding and hiding places. These methods are particularly helpful in destroying cabbage and onion maggots, cutworms, thrips, plant-lice, potato-beetles, and striped cucumber-beetles. In the summer likewise, and especially early in spring, it is important to keep down the weeds, for they promote a rapid multiplication of insects, and provide temporary breeding places for some species pending the appearance of their special garden food-plants. An early cutting of weeds is further beneficial by preventing their seeding.

Importance of Healthy and Vigorous Plants—It is a common observation that healthy and vigorous plants withstand the attacks of insects much better than weak and neglected ones. One of the principal requirements for vigorous growth is fertility of the soil. Good seed is necessarily an important item, and, further, it should be properly planted and the crop should be thoroughly cultivated to secure strong and healthy plants. Such plants will also endure the effects of drouth for a much longer time than weaker plants.

Rotation of Crops—Crop rotation is one of the most valuable of the cultural methods for preventing insect attack. As a rule, it is bad practice in truck-gardening to grow two successive crops of a vegetable, or of nearly related vegetables, successively, on the same piece of land; and, further, a crop should be planted as far as possible from the location of the same vegetable the year before. Especially is rotation desirable when the crop was badly damaged by insects the previous year. Some of the more important insects whose injuries may be checked or controlled by this method, are cabbage and onion maggots, potato-beetles, wireworms, white-grubs and cutworms.

Fall Plowing—Another important means of insect control is fall plowing. In the northern part of Illinois, where the winters are usually severe, the value of this measure seems considerable, for its main object is to bring

the insects in the soil nearer to the surface, where they may be killed by the cold. It is necessary in such localities to plow as late in fall as possible, when the insects are more or less inactive and unable to go very deep into the ground. Disking and harrowing in the fall is often helpful.

Time of Planting—It is often possible to avoid insect attack by either early or late spring planting. The object in planting early is to have the crop well started and sufficiently advanced to withstand insect attack when it occurs; while the object of late planting is to bring the crop on after the disappearance of the insect likely to injure it. I have known of but one instance of such benefit derived from early planting, and this was in the case of the onion-maggot. Late spring planting is a successful measure of protection against some insects, such as cutworms, the striped cucumber-beetle, flea-beetles, etc.

Early Detection of the Presence of Insect Pests—Usually an insect has already done much damage to a crop before its presence is known, and often it is discovered too late for the successful application of remedies. This makes it necessary for the gardener to keep vigilant watch of his crops in order to know when to spray or otherwise to treat them; that is to say, he should detect the presence of an injurious insect in his garden almost as soon as it appears.

Insect injury may be recognized by the actual detection of the culprit; by the failure of seed to germinate; by injury to the leaves; by a wilting of the plants; by the wilting or curling of the leaves, caused by aphid attack; by an uneven stand; or by the slow growth of the plants.

The more important insects known to be injuring garden products in Illinois will now be discussed under the various crops, taken up in alphabetical order. Methods of preparing the principal insecticides used by the gardener are given at the end of the article.

ASPARAGUS.

The area in asparagus has greatly increased in Illinois in the last few years, and the plant is now one of the most important products of several gardening districts. Only one insect—the common asparagus-beetle (*Crioceris asparagi* Linn) has been found doing any considerable damage to this crop, and this in only two localities.* Where present, however, it is an important pest of this plant, and the increasing acreage in asparagus may cause its spread over a much larger territory. The asparagus grower should be on the continual lookout for it, and at its first appearance take immediate measures for its control.

THE COMMON ASPARAGUS BEETLE.

Crioceris asparagi Linn.

Both beetles and larvæ of this species cause injury by feeding on the young shoots as they appear above ground, and by defoliating the plants later in the season. In the first case the young shoots are rendered unsalable or of poor quality, while the loss of foliage greatly weakens the plants, especially seedlings.

The beetle (Fig. 2, *a*) is one-sixth to one-fourth of an inch in length, and is gayly colored, the thorax being reddish, and the elytra, or wing-covers, more or less striped with lemon-yellow and dark blue, and having a reddish border. Early in spring, at the time of the first cutting of asparagus, the beetles emerge from their winter quarters and lay their conspicuous, yellowish, slender eggs (Fig. 2, *b*) end to end, in rows of eight or less, on the stalks or leaves of the asparagus plants. In our experiments a single female, in confinement with a male beetle, laid a total of 386 eggs

*Since the above was written it has been found in other localities, and it is probably only a matter of a few years until it will become common throughout our asparagus-growing districts.

during her life of 29 days—from May 13 to June 11. In about a week the eggs hatch into "grubs," or larvæ (Fig. 2, c), which immediately begin to feed. These become full grown (Fig. 2, d) in about two weeks or less, at which time they are a quarter of an inch in length, or slightly shorter, fleshy, and of an olive color. The mature larvæ go into the earth and change to pupæ (Fig. 2, e) just beneath the surface.

They remain in this condition nine to twelve days, and then change to beetles, which, in turn, come out of the ground and lay eggs for a second generation. The beetles of this generation go into hibernation in the fall, about the middle of September in ordinary seasons. It is not certain that there are but two broods a year in Illinois; the life history has not been



Fig. 1—Common Asparagus beetle, *Crioceris asparagi*, larvæ and adults, on asparagus. Natural size.

completely worked out for this State, but observations made in northern Illinois indicate that in ordinary seasons from two to three broods occur there. We have succeeded in raising three broods in one season in confinement, under what were probably optimum conditions, in the latitude of Chicago.

Methods of Control—Volunteer asparagus plants should be kept down in early spring, as they afford a good breeding place for the larvæ. Since the shoots are cut for the market every day or two, the eggs which may be deposited on them do not have time to hatch; and if the volunteer growth is kept down there will be little chance of any eggs hatching in the field.

Fresh air-slaked lime, dusted on the plants early in the morning, while the dew is on, has been reported by Dr. F. H. Chittenden as destructive to all grubs with which it comes in contact.

Arsenical poisons are of value upon plants that are not being cut for food, and possess the advantage of destroying beetles, as well as grubs. The



Fig. 2—Common Asparagus Beetle, *Crioceris asparagi*: a, beetle; b, egg; c, newly hatched larva; d, full grown larva; e, pupa. Enlarged as indicated.

application should be made at frequent intervals, or as often as the larvæ reappear. Arsenate of lead or Paris green in water are excellent sprays for this purpose. Dry arsenicals are also effective—as Paris green mixed with lime, with lime and flour, or with land plaster.

CABBAGE AND CAULIFLOWER.

In Cook county gardens, cabbage and cauliflower rank in importance with such garden products as onions, cucumbers and potatoes. Not only are they among the most generally grown vegetables, but they are peculiarly susceptible to insect attack. In Illinois I have found the following insects doing noticeable damage to these crops; the imported or green cabbage-worm, cutworms, the root maggot, plant-lice, and flea-beetles.

THE IMPORTED CABBAGE-WORM.

Pontia rapae Linn. (*Pieris rapae*.)

There is not a gardener who is unfamiliar with this common and destructive caterpillar. There are several "cabbage-worms," but the commonest is the larva of the white butterfly (*Pontia rapae*) always to be found flying around cabbage fields during the summer. It emerges early in spring, having passed the winter in the chrysalis or pupa stage. The greenish eggs, small, slender and ribbed, are soon deposited, usually singly, on the leaves of early cabbages or other cruciferous plants. The velvety green larva (Fig. 3, a) begins to feed ravenously on the leaves immediately upon hatching. It gets its growth in ten to fourteen days and becomes a chrysalis (Fig. 3, b) changing to a white butterfly (Fig. 4 and 5) some eight to twelve days later. The length of the season and other general conditions have much influence in determining the number of generations in any year. There are certainly as many as three, on an average, in northern Illinois.

These caterpillars are not only injurious to cabbage, cauliflower, and other cruciferous plants, but they sometimes do much damage to lettuce.

Parasites—There is hardly a field of cabbage or cauliflower infested with these green caterpillars in which we can not find masses of small white or yellowish cocoons. These cocoons are formed by small larvæ which live within the bodies of the cabbage-worms, soon killing their hosts. Minute wasp-like adults emerge from the cocoons, and deposit eggs in the bodies of other cabbage-worms. This parasite (*Apanteles glomeratus*) is a valu-

able friend to the cabbage and cauliflower grower, and it is sometimes abundant enough to free the field of cabbage-worms, at least for the time being. Many gardeners make the serious mistake of destroying the cocoons of this parasite, believing them to be the eggs of the white butterfly.

Another parasite, *Pteromalus puparum*, kills many pupæ, or chrysalides, of this cabbage-worm, and materially decreases the number of the next generation. Often the chrysalides from which the butterfly should have emerged, are dark brownish to black, and when broken open will be found to contain



Fig. 3—Cabbage Butterfly, *Pontia rapae*: a, larva; b, pupa. Natural size.

many maggot-like larvæ or dark brown pupæ. These have developed from eggs deposited in the living chrysalides by adults of *Pteromalus puparum*, which, like the parasite of the larva, is a small wasp-like insect. I have reared 48 to 58 of these parasites from single chrysalides.

In one large gardening district where cabbage and cauliflower are grown extensively, I could not find a single living worm or chrysalis Aug. 26, 1908, although a few weeks before both had been abundant. All had been killed by their parasites.

Remedial Measures—The following remedies are equally effective for any of the several caterpillars feeding on cabbage leaves, with the exception of cutworms, which will be treated later.



Fig. 4—Cabbage Butterfly, *Pontia rapae* male, natural size.

The use of arsenicals on cabbage and cauliflower is often discouraged because of the supposed danger to the consumer. Experiments with arsenate of lead and Paris green have been made, both in New York and in Kentucky, in which the sprayed plants were analyzed to determine the amount of poison remaining on them. It was found that only a slight trace, if any, was present—in no case enough to be dangerous, even if all consumed by one person. Cauliflower, however, should not be sprayed after the "flower" has begun to form, nor should cabbages be sprayed after they are two-thirds grown.

Paris green is one of the standard remedies, and is more used today in spraying for cabbage-worms than any other insecticide. It may be applied dry or suspended in water, and specific directions for either use of it are given at the end of this article (page 256). A resin-lime mixture has been highly recommended by Mr. F. A. Sirrine,* who, after experiments with it, concluded that the yield of cabbages was increased 60 to 100 per cent by the treatment. He figures the cost of it at about \$2.00 an acre. Two applications are usually sufficient. Directions for the preparation of this mixture also may be found on page 256.

Arsenate of lead has been successfully used against the cabbage-worm, but has the disadvantage of not adhering as well as the resin-lime mixture, although better than Paris green alone. It consequently must be applied oftener—sometimes as many as three or four times a year, but ordinarily only twice. It has the advantage of being easy to prepare, and, as it is white, one can easily see when the plants have been thoroughly sprayed.



Fig. 5—Cabbage Butterfly, *Pontia rapae*, female, natural size.

Pyrethrum is also recommended for this insect. It is more expensive than the arsenicals, but has the two advantages over them that it is not injurious to man, and that it can be used later in the season than they,—that is, when the heads are nearly formed.

Hot water at nearly boiling point will, of course, kill the worms, and is said to be harmless to the plants. Lime has been used against these worms, but it is ineffective, especially when they are numerous. Professor J. W. Lloyd says* "cabbage-worms were abundant late in the season, and in spite of five applications of air-slacked lime did considerable damage to the crop."

Cabbage stalks and other debris should be removed from the field in fall and burned, unless, as recommended by Dr. F. H. Chittenden,† a few of the plants are left and poisoned as bait for the last generation of the insects.

THE VARIEGATED CUTWORM.

Peridroma margaritosa Haw. (*Agrotis saucia*, *Peridroma saucia*.)

Cutworms are sometimes very injurious to cabbage, cutting off the young plants and killing them outright. For this reason they are a worse pest than the green caterpillars; but they are not so widespread, and are therefore of less economic importance. The life history of the above species and a description of it are given in connection with insects affecting lettuce (pages 240-242).

Remedies—Poisoned bait (see page 260) is probably the best remedy for cutworms. If they are known to be present, the bait should be put on the prepared field just before the cabbage plants are set out. If not, it should be used as soon as the presence of cutworms is recognized.

*A Spraying Mixture for Cauliflower and Cabbage-worms. Bull. N. Y. Agr. Expr. Station, No. 144 (Sept., 1898) Geneva.

*The Farmers Vegetable Garden. Bull. Ill. Agr. Expr. Station, No. 105, (Feb., 1906), p. 190.

†Insects Injurious to Vegetables, p. 139. Orange Judd Co., New York, 1907.

Spraying with an arsenical poison, such as Paris green, will destroy some of the insects if the spray is applied to the stems near the ground; but the stalks are probably more frequently cut off just below the surface of the ground than just above it, and in the former case the poison would not be eaten by the cutworms.

The collection of cutworms by hand is advised for some crops, but it would generally be too expensive for large cabbage fields.

THE CABBAGE ROOT-MAGGOT.

Phorbia brassicae Bouché. (*Pegomyia brassicae*, *Anthomyia brassicae*.)

One of the most destructive enemies of cabbage and cauliflower in Illinois is the cabbage root-maggot. It is white or cream colored, resembling the onion-maggot (Fig. 25), which is known to all Illinois gardeners. It is one of the immature stages of a fly which is much like the housefly in ap-



Fig. 6—Cabbage seed-bed with frame and screening in position, to keep out the Cabbage Maggot, *Phorbia brassicae*.

pearance, but more cylindrical, somewhat smaller, and of a grayish or brownish color. The winter may be passed in either the adult, puparium, or maggot stage, the flies hibernating in rubbish, buildings, or any accessible place that will afford shelter, the puparia in onion bulbs left in the fields in the soil, and the maggots in the refuse bulbs. Early in spring the flies deposit their small, elliptical white eggs in small cracks and crevices near the stem of the plant, or on the stem beneath the surface. Usually within a week—not so soon if the weather is cool, but often within 24 or 36 hours in the warmer parts of the year—small maggots hatch from the eggs, and immediately go into the ground and begin to feed on the roots or stalk. Becoming full grown in a few weeks, they leave the roots to pupate in the soil near by. They remain in this dormant stage, as oval brown puparia, for about two weeks (in summer), and from these the adult flies emerge. There may be two or more generations in Illinois, according to the length of the season.

Most of the injury to cabbage and cauliflower by this maggot is done while the plants are small, and particularly to early cabbage. For this reason the acreage of early cabbage has greatly decreased in this State within the last few years.

Economic Control—Many methods have been recommended by various writers for the control of the cabbage root-maggot, but most of these are preventive rather than remedial. Cabbage seldom brings a high price, and many measures that have been proposed are impracticable because of their cost.

For the *prevention of maggot attack in seed beds*, probably the most successful and practical method of protecting the young plants is that of screening them, as suggested by Dr. James Fletcher,* and later successfully demonstrated on a large scale by Mr. W. J. Schoene.† This consists in growing the seedlings under cheap frames, made of light wood and covered with cheesecloth (Fig. 6), to protect the plants from the cabbage-maggot flies. In Mr. Schoene's experiments it proved very successful. He says: "Plants raised under cloth grew faster and reached the desired size for transplanting one week before the seedlings in the check [untreated] area. The screen sets were seasoned by the removal of the covering thirteen days before the time of replanting, and showed no more wilting when transplanted than did the check seedlings."

"The screened bed was entirely free of maggots, and produced 50,000 sets, which were replanted. The check bed, of more than three times the size, yielded only 30,000 desirable plants. The cabbage maggots were generally very destructive to unprotected seedlings."

The total cost for material was approximately 40 cents for each 1,000 plants. The screens not only protect the plants from maggots, but also from the flea-beetles, which often do much damage to young cabbage.

For the *destruction of maggots at the time when seedlings are to be transplanted*, roots not too badly infested for use should either be washed off with water before resetting them, in order to remove the maggots, or, as Professor F. L. Washburn suggests,* they may be dipped in a decoction of white hellebore—one part of the powder to two parts of water. The latter treatment is preferable, for while the water will have no effect on the maggots except to remove some of them, the hellebore may kill them all.

For the *prevention of maggot attack after transplanting*, probably the most successful measure is the use of tarred-paper cards. Those ordinarily used are made of a thin grade of tarred felt-paper, and are about two and a half inches in diameter. They may be of any shape, but, as a matter of economy, are usually hexagonal, with a slit from one side to the center. The card is placed on the plant by separating the two edges of the slit and slipping the card around the plant so that the stem comes in the middle of the card. The card must then be pressed close to the stem and flat on the ground. This being done, the female fly must lay her eggs either on the card—where there is small chance of their hatching—or on the stem—and if the card is close to the stem the young larvæ hatching from them will be unable to reach the roots—or else on the ground beyond the card, in which case the young larvæ, hatching so far from the plant, would probably be unable to reach it.

A carbolic acid and lime mixture (see page 260) has been recommended by others, but in our experience it proved worthless, the coat of lime cracking and leaving places for the deposit of eggs. After 24 hours the carbolic acid loses its value as a repellent. The mixture is applied along the rows with a sprinkling-can or spray-nozzle as the plants are transplanted, and in such manner as to coat the entire surface thinly around the plants.

Tobacco dust placed around the base of the plants has been found to prevent the female from depositing her eggs on or near them.

*Insects Injurious to Grain and Fodder Crops, Root Crops and Vegetables. Bull. Central Experimental Farms, Ottawa, Canada, No. 52 (June, 1905), p. 35.

†Screenings for the Protection of Cabbage Seed Beds. Bull. N. Y. Agr. Exper. Station, No. 301 (March, 1908), Geneva.

*The Cabbage Maggot and other Injurious Insects of 1906. Bull. Minn. Agr. Exper. Station, No. 100 (Dec., 1906), p. 12. St. Anthony Park.

When these maggots have once gained a foothold in a cabbage field it is difficult, if not impossible, to exterminate them. The only practical insecticides which have been recommended are the carbolic acid emulsion, a decoction of hellebore, and carbon bisulfid (see pages 259 and 262), and these have given quite variable results. The carbon bisulfid has been used with success, but the expense of application prohibits its use in large commercial gardens. Hellebore decoction has given us very good results. A third of a pint should be poured at the base of each plant when transplanted, and each week thereafter for three or four weeks.

In using these insecticides it is necessary to make thorough application at the base of the plant before the maggots have had a chance to enter the root and protect themselves.

The application of commercial fertilizers is of much value. They stimulate the plant and make it more resistant to maggot attacks.

Clean farming and fall plowing aid in preventing maggot attack.

The use of "blood and bone," with hellebore, was suggested to us by a gardener, who reported that some of his cabbages had been protected from this maggot by this means, while plants not so treated were seriously damaged by it, as in previous years. We tried this material this year (1910), placing a small quantity of the dry mixture about each cabbage plant after transplanting to the field, but unfortunately for the test, the maggots were not present in injurious numbers either in the treated or untreated plots, and therefore no definite conclusions were reached. Upon examining the "blood and bone" around the plants, however, we found in it many maggots which were bred to adults and determined as *Phorbia fusciceps* Zett, a species closely related to the cabbage and onion maggots, and often injurious to the same crops. The same species infested "blood and bone" when applied to onions, the mixture being in this case drilled in on each side of the row. Although no recommendations can be made from these tests, it is thought best to make brief record of them.

THE CABBAGE PLANT-LOUSE.

Aphis brassicae Linn.

During midsummer or early fall this plant-louse becomes noticeably abundant on cabbage and cauliflower plants, usually infesting the under sides of the leaves in large, packed colonies, which rapidly increase in size unless checked by enemies or unfavorable weather. Both wingless and winged individuals are to be found, and though there are few of the latter as compared with the multitudes of the former, these few winged lice are the chief means of starting colonies in uninfested fields. Like other plant lice, the cabbage-louse gives birth during the summer months to living young, without previous fertilization of the female by the male. In the fall, as observed by Fletcher, Garman, Quaintance, and others, both sexes are produced, and eggs are deposited on the stems and leaves of cabbages remaining in the field. Sometimes, however, viviparous females are found as late as mid-winter, within the cabbage heads.

The lice are about the size of a pin-head, soft-bodied, pale greenish, but completely covered with a whitish powder or bloom which is not unlike the bloom on cabbage leaves.

Plant-lice injure cabbage by sucking the juices of the plant. When abundant, they so disfigure and stunt it, especially the smaller and weaker plants, that it becomes unfit for market.

Natural Checks—If it were not for the natural checks on its increase, the cabbage plant-louse would be one of the very worst pests with which the cabbage grower has to deal; but wet weather and its insect enemies greatly restrict its multiplication. It is not only subject to attack by many minute parasites, but it is preyed upon by several kinds of "ladybird" beetles and by the larva of a lacewing fly (*Chrysopa*), whose combined attacks greatly lessen the numbers of the aphids, and hold them in check.

Remedies—Probably the most successful method of dealing with the cabbage-louse is fumigation with carbon bisulfid. This substance was tested by us in the fall of 1908 on cabbages badly infested with plant-lice. Fumigation of cabbage or cauliflower on a commercial scale with individual covers for the plants would be too expensive for profit; but an economical method is to cover a considerable area of plants with large canvass or muslin sheets, with props at the corners and center, and wherever else may be necessary.* The cover being ready, dishes are placed beneath it containing the carbon bisulfid at the rate of a teaspoonful to each cubic foot of space. The edges of the cloth, which should lie on the ground, are covered with earth to prevent, as far as possible, the escape of the fumes. After forty-five minutes to an hour the cover may be removed. This treatment also killed the thrips and cabbage-worms which infested the plants, but it did not kill the parasites concealed in the aphid skins—which fact is greatly in its favor. With exposures of 20 and 30 minutes, nearly all the lice were killed; but

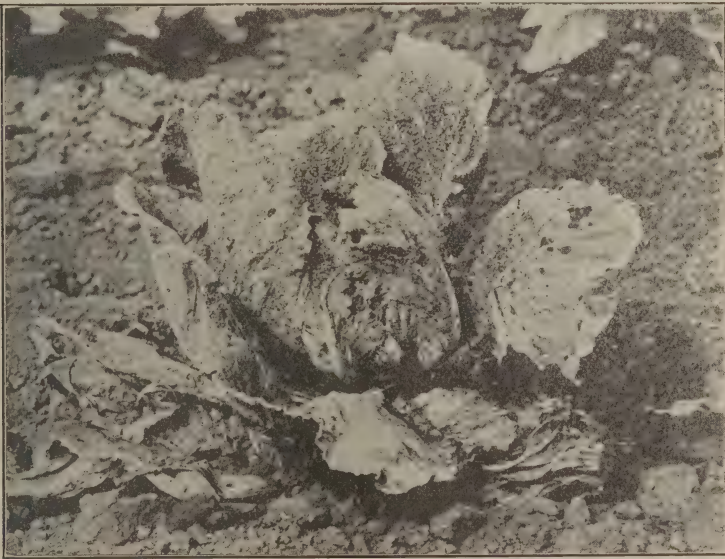


Fig. 7—Cabbage Plant-Louse, *Aphis brassicae*, on head of cabbage.

with only 15 minutes or less, practically none were killed. (For other particulars concerning the use of carbon bisulfid see page 262.) Mr. C. E. Sanborn† has recommended the use of "Aphis Punk" or "Nico-Fume" paper in fumigating plants under cover.

Kerosene emulsion of a 10 per cent strength is the standard spray for the cabbage plant-louse. Care should be taken to spray thoroughly the under side of the leaves, where the lice are usually most abundant, for the liquid must come in contact with the insects in order to kill them. (For formula, etc., see page 258).

Tobacco decoction and various soap mixtures have been recommended for this plant-louse, but they are less effective than the kerosene emulsion. It is hardly necessary to say that treatment should begin at the first appearance of the lice.

*The Melon-louse and other Aphids, by C. E. Sanborn. Bull. Texas Agr. Exper. Station, No. 89, (not dated) page 47. College station.

†Loc. cit.

Clean culture, especially the destruction of the cabbage and cauliflower stalks in fall, is very important, to destroy the eggs which are deposited on the cabbage and related plants, and likewise to destroy the young and adult lice which may be hibernating on the same kinds of plants.

THE CABBAGE FLEA-BEETLE.

Phyllotreta vittata Fabr.

This flea-beetle, often very abundant and destructive, is the only one of the many flea-beetles—so named because of their remarkable leaping ability—which has been found injuring cabbage in northern Illinois. It is a black, shining, oval beetle (Fig. 8, *a*) about .08 inch long, with a broad, wavy longitudinal marking of pale yellow on each wing-cover. It sometimes injures other crops, especially radishes, and its food plants include many weeds. It injures plants by eating innumerable holes and pits in the leaves. It is most destructive to cabbages early in the year, when the plants are less than two inches high, at which stage they easily succumb to such attacks.

I quote in full the concise paragraph on the life history of the immature stages of this flea-beetle given by Professor H. Garman.*

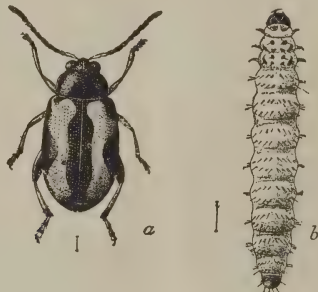


Fig. 8—Cabbage Flea-beetle, *Phyllotreta vittata*: *a*, beetle; *b*, larva. Enlarged as indicated.

"The early history of the cabbage flea-beetle was made out in 1865 by Dr. Shimer, of Mt. Carroll, Illinois. He found that the larva [Fig. 8, *b*] feeds on the roots of cabbage, in which respect it is different from a very similar European beetle, and also from the next one [*P. sinuata*] treated in this paper, both of them being leaf-miners. The eggs of this beetle are placed at the base of the plant. The grubs hatching from them work their way into the earth, mining and feeding on the roots, in some cases completely destroying the plants. When fully grown they are about one-fifth inch long, yellowish white in general color, the head dark brown. They desert the roots when ready to change to pupæ, and pushing into the earth a short distance, make a small cell, in which the change takes place."

Prevention and Remedies—A useful method of preventing flea-beetle attack recommended by Mr. W. J. Schoene,† consists in screening the seed beds, as described on page 223 for the protection of seedlings against the attacks of the cabbage root-maggot. The most effective treatment is spraying with Paris green or arsenate of lead, using Bordeaux mixture as a diluent (see pages 256 and 257). To use Bordeaux is not absolutely necessary, but as it is a powerful repellent it adds to the value of the spray.

*Insects Injurious to Cabbage. Bull. Ky. Agr. Exper. Station, No. 114 (June, 1904), p. 37. Lexington.

†Bull. New York Agr. Exper. Station, No. 301 (March, 1908), p. 170. Geneva.

Many other remedial measures have been recommended, such as powdering the plants with air-slaked lime, soot, road dust, wood ashes, tobacco dust, etc., these substances acting as repellents, or with Paris green and lime—though the latter mixture is more effective as a liquid spray; and spraying kerosene emulsion around the base of the plants is said to destroy the eggs and young larvæ of this insect.

Cultural Methods—As this flea-beetle feeds on many weeds, especially the crucifers, all weeds in the immediate vicinity of the garden should be destroyed.

CUCUMBER AND MELON.

Cucumbers and melons are among the most important garden products in Illinois. In 1899, 2,580 acres were devoted to cucumbers, and 466,876 bushels were marketed. This report does not include cucumbers grown throughout the State under many hundred thousands of square feet of glass. The same year there were 10,963 acres in watermelons and muskmelons in Illinois. The acreage in both these crops has greatly increased since 1899.

The most important insect enemies of these plants are, outdoors, the striped cucumber-beetle, the squash-bug, and the melon aphid; and, in greenhouses, thrips and the white-fly. Although they are not insects, two other greenhouse pests should be mentioned, namely, the red spider, and a nematode worm commonly known as the eel-worm.

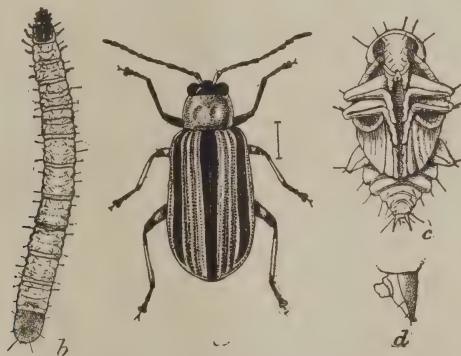


Fig. 9.—Striped Cucumber Beetle, *Diabrotica vittata*: a, beetle; b, larva; c, pupa; d, tip of larva, side view. Enlarged as indicated.

THE STRIPED CUCUMBER-BEETLE.

Diabrotica vittata Fabr.

Ordinarily this is a pest which the gardener must carefully guard against. As the young cucumber, melon, or other cucurbitaceous plants make their appearance above ground, they are attacked by these ravenous beetles, and large areas may be killed by them in a few days.

The beetle (Fig. 9, a) is small (about two-fifths of an inch long), with black head, yellowish thorax, and yellowish wing-covers, marked lengthwise with three black stripes. It passes the winter in the ground or beneath boards or similar shelter, and as the young food plants appear above ground—usually about the first week in June—it comes forth and feeds on their leaves. If the beetles are at all abundant they may soon devour the small tender plants. They feed continuously and voraciously for a week or ten days, and then commence to pair. The eggs (Fig. 10) are deposited singly, and may usually be found on the under surface of the leaf, on the stem near its base, or on the ground near the plant. The larvæ (Fig. 9, b, d) upon hatching, feed within the stalks or on the roots, or sometimes on the

fruit and vines as they lie upon the ground. The length of the larval period no doubt varies greatly, depending on the food supply and climatic conditions. The pupa (Fig. 9, c) is formed in an earthen cell in the soil, and the transformation to the adult beetle is completed within 7 to 14 days. Although the beetles of this new generation begin to emerge the latter



Fig. 10—Striped Cucumber Beetle, *Diabrotica vittata*, egg, much enlarged, with portion of surface more highly magnified at right.

part of July, they may continue to appear throughout August. Professor Garman, in his studies of this insect,* found that in confinement the entire life cycle of an individual was 26 to 33 days. It is possible that a second generation may appear in the southern part of the State, but in northern Illinois probably but one full generation occurs under normal conditions.

Preventive and Remedial Measures—A large number and variety of methods for the control of this insect have been recommended, but only those which have given promising results will be discussed. One of the oldest methods for protecting the young plants from the cucumber-beetle is covering them with a screen; but while this is very satisfactory in small gardens, it is not so practicable on a large scale as the use of the Bordeaux mixture in connection with a trap crop, as discussed farther on. It has been found that for a short time in spring, before the beetles begin to pair, they may be killed with a spray of Paris green or arsenate of lead, but that they will not feed readily upon sprayed foliage after pairing, and arsenicals alone can not be generally recommended for the cucumber-beetle without further tests of their efficiency.

The use of squash as a trap crop (Fig. 11) in combination with a spray of Bordeaux mixture or Bordeaux and arsenate of lead on the cucumber plants and an arsenical poison on the squash, is one of the best means of preventing the attacks of these beetles. Mr. F. A. Sirrine has given a very complete account of this method of treatment based on his own experiments, and the following is taken largely from his paper:†

Squash seed is planted around the margin of the field about four days' previous to planting it with cucumbers, or other crop.§ At the time of cucumber planting there should be a second planting of squash seed on the margins of the field. At the first appearance of the beetles about half the squash vines should be dusted with some easily obtainable arsenite, and soon after the cucumber plants appear above ground they should be sprayed with Bordeaux mixture, using the 4-4-50 formula (for preparation see page 257). At about the same time the cucumber plants are sprayed with Bordeaux the squash-vines should again be dusted with an arsenite. Two weeks after the cucumber plants have appeared all the squash plants may be removed, except a few which should be left until the cucumber vines have set fruit, as the beetles will feed on the squash flowers in preference to those of the cucumber. Sirrine recommends spraying the cucumbers with Bordeaux mixture three times; first, as soon as the seed leaves are exposed; second, when the third true leaf appears; and last, just before the plants commence to vine. He says: "The cost of three applications of the Bordeaux mixture will not exceed \$2.00 per acre; whereas, the cost of wire covers would be \$40.00 per acre, and they probably will not last over three years."

*Enemies of Cucumbers and Related Plants. Bull. Agr. Exper. Station, No. 91 (March 8, 1901), p. 5. Lexington.

†Combating the Striped Beetle on Cucumbers. Bull. N. Y. Agr. Exper. Station, No. 158 (May, 1899), pp. 14-16. Geneva.

§Mr. Sirrine informs us that only the Hubbard or the Boston Marrow squash should be used, these being by far the most attractive to the beetles.



Fig. 11.—Cucumber field with squashes along its border to attract the Striped Cucumber Beetle.

Repellents are effective against this beetle, and Bordeaux mixture is one of the best, although it is best to use it in connection with a trap crop, as above described. Other much-used repellents are air-slaked lime, land-plaster, sifted ashes, road dust and tobacco dust, but these are not always effective when the beetles are abundant.

Clean culture will prevent much of the damage commonly done by many of the common garden pests, and it is especially effective against the cucumber-beetle. It has been recommended in this connection, that as soon as the crop is harvested the vines be covered with straw and burned. This is a far better practice than that of gathering them up before destroying them, as the latter procedure leaves many of the beetles undisturbed in the field.

THE SQUASH-BUG.

Anasa tristis DeGeer.

The squash-bug, although confining its attacks largely to the squash and other plants of the gourd family, is often very injurious to the cucumber in early spring, when emerging from its winter quarters. It finds its way into the cold frames in which the plants are being started, when no other food plant is available.

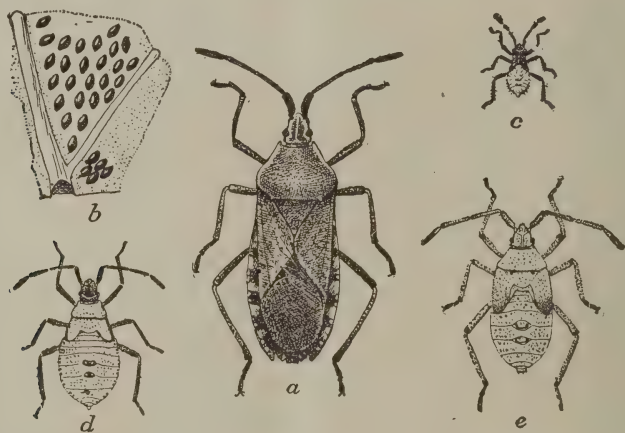


Fig. 12—Squash-bug, *Anasa tristis*: a, adult; b, egg cluster; c, d, e, young in different stages. Twice natural size.

This large, ill-smelling, dark brown bug (Fig. 12, a) hibernates as an adult in rubbish, sheds, and wood-piles, under loose bark on stumps, or in any other available place of protection. In northern Illinois the bugs make their appearance about the middle or the last of June, or even later; but I have found most of their injury to the cucumber done while the young seedlings are in the cold frames. In all such cases these frames were near wood-piles or out-buildings, and during the occasional warm days of spring, when the frames were opened, the bugs gained entrance, the temperature of these beds making them fully active. Shortly after coming from their winter quarters they deposit the conspicuous clusters of glossy yellowish-brown eggs (Fig. 12, b), usually on the under side of the leaves. The young, light grey bugs (Fig. 12, c) hatching from these, immediately begin sucking the juices of the plants. In their later immature stages (Fig. 12, d, e)—which differ only in size from the young bug as it hatches from the egg—they feed, as do the adults, upon the juices of the plant. The loss of sap,

however, is not the primary cause of the wilting of the plants. This is due principally, if not wholly, to a liquid poison which the bug introduces into the wound which it makes. In some cases it also gives entrance to a bacillus which causes a wilt disease.

Methods of control—Collecting the bugs under board traps is probably the most satisfactory of the various methods suggested for the control of this pest. This should be done in early spring, as soon as the bugs appear. The boards are simply laid on the ground as a decoy shelter for them during the night, and here they may be easily captured early in the morning. The eggs should likewise be collected and destroyed as fast as they are laid on the leaves.

Kerosene emulsion kills the young bugs without injuring the plants if it is very carefully applied, but it is too dangerous for ordinary use.

Here again clean-farming methods are of much importance. Cold frames should be placed at some distance from wood-piles and out-buildings, and as soon as the crop has been gathered the vines should be covered with straw or other easily inflammable material and burned.

THE MELON APHIS.

Aphis gossypii Glover. (*Aphis cucumeris*).



Fig. 13—Melon Aphis, *Aphis gossypii*, its work.

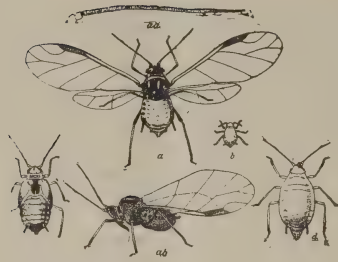


Fig. 14—Melon Aphis, *Aphis gossypii*: *a*, winged female; *aa*, enlarged antenna of same; *ab*, dark female, side view; *b*, young nymph or larva; *c*, last stage of nymph; *d*, wingless female—all greatly enlarged.

Although the truck gardener may not have noticed the melon-aphis on his cucumber plants, a curling of the leaves (Fig. 13) is presumptive evidence of its presence in injurious numbers. It is not only a serious outdoor pest, but is often very injurious to cucumbers in greenhouses.

This plant-louse (Fig 14) varies in color from pale yellowish to blackish green. Its life history and insect enemies are very similar to those of many other plant-lice, such as the one which has already been discussed as a cabbage insect (page 225). Briefly, the melon aphis appears on cucumber and melon plants early in the season, and increases rapidly in numbers during the summer unless checked by its insect enemies or by unfavorable weather. It is still doubtful whether it ever produces eggs to carry the species over winter, but it is known that viviparous females—the form found throughout the summer—may hibernate in some parts of Illinois.

Remedial measures—The measures recommended for the control of the cabbage-louse (p. 226) may be used against the melon aphis, and of these, fumigation with carbon bisulfid is doubtless the most efficient (see page 262).

Owing to the large number of its food plants, clean culture is especially important in dealing with the melon aphis, particularly the cutting and burning of weeds and old vines; and fall plowing is also advisable.

In greenhouses, fumigation with hydrocyanic gas is doubtless the best treatment for this insect. The procedure is described on pages 261-262.

THE GREENHOUSE WHITE-FLY.

Aleyrodes vaporariorum Westwood.



Fig. 15—White Fly, *Aleyrodes vaporariorum*, nymphs on leaf. Twice natural size.

One of the most troublesome and destructive insects with which the greenhouse vegetable-gardener must deal is the white-fly. This little pest attacks cucumbers, tomatoes, peppers, and lettuce under glass, and a considerable variety of flowering and ornamental plants.

The winged adult (Fig. 16) is about .06 (one seventeenth) of an inch in length, and looks as if dusted with flour. The minute irregularly ovoid eggs are deposited on the under surface of the leaves, to which each is attached by a very short, slender stalk. Recently hatched larvæ are flat, oval in outline, and transparent or translucent according to age. They settle on the leaf close to the empty egg-shells, soon attach themselves, and there remain (Fig. 15), molting four times and becoming adult with the last molt. The entire life cycle of the white-fly from the time the egg is deposited until the adult emerges, is completed in a month to five and a half weeks, at the ordinary greenhouse temperature in summer.

The larvæ and pupæ secrete a honeydew which falls on the leaves below them; and on badly infested plants, where this liquid becomes abundant, a sooty fungous growth appears on the leaves covered with it, which hastens the death of the plants.

Parasites—In the University greenhouse, at Urbana, many of the plants, especially *Salvia* and pansy-geranium, were badly infested in the midwinter of 1908 by the little white-fly, but two months later these insects were found to have been almost exterminated by a minute hymenopterous parasite, which proved to be a new species, and has since been described by Mr. A. A. Girault as *Encarsia versicolor*.* It attacks the immature forms of the white-fly, and the infested young may be recognized by their black color, those not infested being pale greenish.

Remedies—Fumigation with hydrocyanic acid gas is by far the most efficient means known for controlling the white-fly in greenhouses. In ordinary greenhouses it may be used at a strength of one ounce of cyanide of



Fig. 16—White Fly, *Aleyrodes vaporariorum*, adults on leaf. Twice natural size.

potassium to 3,000 cubic feet of space. In new tightly built houses a smaller quantity may be used; but in very loosely built or weather-shrunk houses more must be used. The mode of using this gas is described on pages 261-2. It is commonly necessary to fumigate three or four times, at intervals of about two weeks.

Fumigation with tobacco stems, or with any of the commercial tobacco extracts, is partially effective against this insect, and where the use of

**Encarsia versicolor* species novum, a Eulophid Parasite of the Greenhouse White-fly, *Aleyrodes vaporariorum* Westwood. Psyche, Vol. XV, No. 3 (June, 1908), pp. 53-57. Cambridge, Mass.

hydrocyanic acid gas is impracticable this treatment is recommended (pages 260 and 263). More fumigations will be required, but is persistently followed up, the white-fly can be kept in check by this means.

THE ONION THRIPS.

Thrips tabaci Lind.

This insect, which is very injurious to cucumber plants in the greenhouse, is discussed in connection with its injury to the onion (page 246). In the greenhouse its life history is the same as out-of-doors, excepting that the life cycle varies greatly in length under the various artificial conditions which prevail in greenhouses. As a rule, cucumbers are started under glass in fall, and it is at this time that the thrips migrates from outdoor vegetation into the houses. It breeds successfully on almost any kind of greenhouse vegetation, and may soon become well established; but it is not usually until midwinter that it becomes abundant enough to alarm the gardener.

Remedial Measures—Clean culture is one of the most important means of holding this pest in check. As a rule the grasses and weeds around greenhouses are badly infested with thrips in summer, when the greenhouses are not in use, and on these plants it continues to breed until fall, when the seed heads of such plants as pigweed (*Amarantus retroflexus*), wild sunflower (*Helianthus retroflexus*), and foxtail grass (*Chaetochloa viridis*) are filled with winged thrips ready to migrate into the houses. It is very important, consequently, that all weeds should at least be kept down by cutting, though it is much better to cultivate the land several times during the summer to prevent weeds and grasses from coming up. Cold frames to be used in starting young plants should not be placed near an infested onion field, nor where vegetation is allowed to grow wild.

Spraying and fumigation with tobacco extracts (pages 260 and 263) throughout the fall and winter will hold the thrips in check. The gardener should not wait until his plants are visibly injured, but should continually look for the insect, and as soon as the first thrips is found, should begin operations.

Hydrocyanic acid gas has been used by some with apparent success. In a small greenhouse containing 4,500 cubic feet of space, we were successful in killing 99 per cent of the thrips, without injury to the cucumber plants, by using the gas at a strength of one ounce of cyanide of potassium to 2,000 cubic feet. The maximum and minimum temperatures throughout the period of fumigation, which lasted all night, were 74° and 65° F. respectively.

Kerosene and soap emulsions (pages 258-9) are effective against the thrips before the plants have made much foliage, but at a later period it is impossible to spray thoroughly under the surface of all the leaves, and as these emulsions kill by contact it is of the greatest importance to reach all the insects.

Dipping the leaves of small plants in a soap solution just before transplanting them to the greenhouses has been found useful when plants become infested in cold frames.

THE RED SPIDER.

Tetranychus bimaculatus Harvey. (*Tetranychus telarius*).

This common pest is a tiny mite rather than a true spider. It has been a source of trouble to the indoor cucumber grower for years, and although it can usually be kept in check by careful and thorough cultural and spraying methods, it is a veritable pest when it once obtains a foothold. It is a general feeder, and among the outdoor vegetables which it often injures are celery and eggplant.

This mite (Fig. 17 and 18) is so familiar to growers that a brief description will suffice. It is about one fiftieth of an inch long, oval, with four pairs of legs, and usually a dark spot on each side. This latter character,

however, is not constant. The general color also varies, some mites having a decidedly reddish tint, while others are almost colorless. They spin fine webs over the surface of the leaf—usually on the under side—beneath which they live, and it is largely for this reason that they are hard to reach. The minute eggs are globular, pale and transparent when deposited, but later change to reddish. They are commonly placed on the under surface of the leaf, but sometimes on other parts of the plant. The young mites mature in about ten or twelve days.

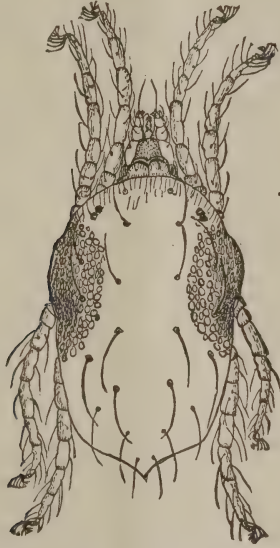


Fig. 17—Red Spider, *Tetranychus bimaculatus*, male, greatly magnified.



Fig. 18—Red Spider, *Tetranychus bimaculatus*, female, greatly magnified.

Remedial Measures—This pest can usually be held in check, or even exterminated, by thorough and timely spraying of the plants with water, if the spray is fine and the pressure considerable; but this is a preventive rather than a remedial measure, for, owing to the excessive rate of multiplication of the mites in a hot, dry atmosphere, and owing further to the fact that the web beneath which they live becomes denser as their numbers increase, the spraying is ineffective unless it is done while the infestation is still slight. Indeed, no treatment is of much practical value if the mites have become well established on living plants. A special nozzle introduced by Dr. B. T. Galloway, of the U. S. Department of Agriculture for use against the red spider is very effective, "As it readily serves to keep the leaves in a thoroughly healthy condition, and at the same time wets the beds but little."*

Fumes of sulphur or hydrocyanic acid gas will kill the red spider, but the strength required is by far greater than the plants will stand. After the cucumber or other crop has been gathered, and before infested vines have been removed, it is advisable to fumigate them with one of these two substances, using one ounce of cyanide of potassium to one hundred cubic feet of space, or burning one pound of sulphur to one thousand cubic feet. It is hardly necessary to say that these strengths will kill living plant. (For full directions for the use of these materials, see pages 261 and 263.)

Sulphur is one of the best remedies for the red spider, and most of the remedies that have been recommended require sulphur as one of the ingredients. Liberally dusting the plants with sulphur after syringing is effective, or, better, applying a spray consisting of one ounce of sulphur to one gallon of water. A little soap added to this sulphur solution will increase its efficiency.

Soap solutions, either whale oil or a neutral soap such as the "Ivory," are of great value in the eradication of the pest, but the addition of sulphur as mentioned above increases their value.

A lye-sulphur mixture has recently been recommended by Dr. F. H. Chittenden, and is said to be more effective than any of the many other materials tested. Directions for preparing this spray are given on page 260.

Whatever insecticide is used, especially when the infestation is severe, should be applied with as great pressure as practicable, for the greatest trouble in controlling this mite arises from the difficulty in penetrating the web which it spins. The stream should also be directed to the lower surfaces of the leaves, for it is here that the spider is most often found.

THE EEL-WORM.

Heterodera radicolica Greeff.

The Eel-worm is a common pest in hothouses, particularly injurious to the cucumber, and, unfortunately, it is apparently becoming more widespread each year. In Illinois it is known only as a greenhouse pest, and our observations indicate that here, at least, it is unable to survive the winter in the field.

The only unmistakable indications of the presence of this root-feeding worm are the swellings or enlargements of the roots (Fig. 20) often referred to by the gardener as root-knots.* These root-knots vary in size and shape, largely according to the number of worms present, to their position on the roots, and to the kind of plant. The presence of eel-worms may be indicated by a sickly appearance of the plant, by the dying of its leaves, and by its final collapse, although nothing but an examination of its roots can certainly incriminate the species. Plants are commonly half grown or bearing fruit before they are noticeably weakened by the eel-worm.

*The Common Red Spider, by F. H. Chittenden. Circ. U. S. Dept. of Agr., Bur. of Ent., No. 104 (Jan. 26, 1909), p. 8.

*This deformity should not be confused with the club-root of cabbage and related plants, which is due to bacterial disease.

The young eel-worm (Fig. 19) is very minute and elongate. It is provided with a spearlike organ projecting from the head, and with this it pierces the tender root (Fig. 21), in which it ultimately imbeds itself. The worms continue to grow—in width rather than in length—within the root, the female finally becoming club-shaped, but the male resuming its original slender form. The young, hatching from the eggs laid within the root, make their way into the soil, and thence into new roots.

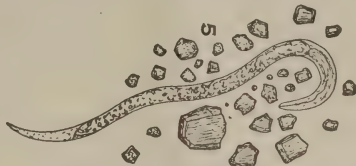


Fig. 19—Nematode Worm, *Heterodera radicum*, among particles of soil. Greatly magnified.

Preventive and Remedial Measures—Tools which have been used in soil infested by eel-worms should be thoroughly washed or, better, sterilized before using them in other soil.



Fig. 20—Cucumber roots showing galls of a nematode, *Heterodera radicum*.

Among the most suggestive methods of treating infested greenhouses is that used by Mr. W. F. Preston, of Dixon, Illinois. Having had serious trouble with nematodes on cucumber plants, he used the sterilization process about to be described, but, owing to the "solid bed," worms in the unsterilized soil below soon reinfested the treated soil. To prevent this, a cement floor was put in the bed about ten inches below the top, the wooden sides being retained. The nematodes did not reappear until the following summer, when the vines were old and ready to be removed, as was also the soil. They then gained entrance between the cement floor of the bed and the wooden side-walls. The soil could probably be wholly protected by making the sides as well as the floor of cement, sloping the floor from the center towards each side, and leaving holes along the sides, near the floor of the bed, for drainage.

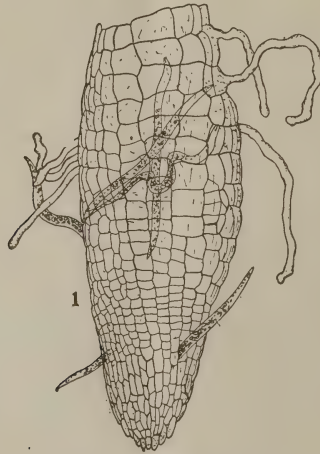


Fig. 21.—Tip of cucumber root with young nematodes, *Heterodera radiculicola*, just entering. Enlarged.

Sterilization of the soil by steam is the most efficient measure of controlling the eel-worm, as well as many insect pests ordinarily introduced into the greenhouse with the soil, and various ways of accomplishing this have been devised by hothouse gardeners. Perhaps the earliest record of this soil treatment is that of Mr. W. N. Rudd,* of Chicago, who used it successfully in 1893. The most practical and economical method with which I am acquainted, is that of Mr. J. F. Ammann, of Edwardsville, Illinois. Into a sterilizing bin of rough boards, measuring two feet high, 10 feet wide, and 20 feet long, about a foot of soil is placed, and a heating apparatus of five "runs" of old perforated two-inch pipe is laid and connected with the steam supply. Another foot of soil is added, and potatoes are placed in the bin, one at each end and another in the center. The bin is then covered with a tarpaulin, and 80 pounds of steam are turned into the pipes for about an hour and a half, or until the potatoes are well cooked.

LETTUCE.

The cultivation of lettuce, though carried on throughout the year, is confined to hothouses during the cooler months. The hothouse product is far the most important, and it is to this that insect pests are the most troublesome. Cutworms, the lettuce plant-louse, and the cabbage-worm are usually abundant enough to do it much damage, and need the close attention of the lettuce grower.

*Killing Grubs in Soil. American Florist (Chicago), Vol. IX, Sept. 28, 1893, p. 171.

THE VARIEGATED CUTWORM.

Peridroma margaritosa Haw. (*Peridroma saucia*, *Agrotis saucia*.)

Young lettuce, cabbage and other plants, are often cut off, or otherwise eaten, by some unseen insect, and later the leaves may be so badly eaten as to ruin them for market. In such cases if one searches near the plant, just beneath the surface of the soil, he is almost certain to find a grayish or dark fleshy cutworm.

The only cutworm I found feeding on lettuce and other vegetables in the greenhouses and out-of-doors in 1908 was the species named above. The egg (Fig. 22, *e*) from which it hatches is about one-fiftieth of an inch in diameter, dome-shaped, with vertical ribs. When first laid it is creamy white with a pearly luster, but it soon changes to a pinkish tint, and finally to lilac or darker. The parent moth may deposit 500 eggs, or even more, in masses of 60 and upwards (Fig. 22, *f*). The larva hatches in five or six days, and after eating the egg shell from which it has emerged, begins feeding on the lettuce leaf. When full grown (Fig. 22, *b*, *c*, *d*) it is about an inch and a half long. It is usually dull, blackish brown, mottled with gray, some larvæ being paler and others darker. A characteristic marking is a row of four to six yellowish dots along the median line of the back. This cutworm feeds at night, and hides during the day in the soil just beneath the surface, or under boards or rubbish near the plant. It remains a cutworm for 25 to 30 days, and then goes into the ground and pupates in an oval earthen cell, usually found just below the surface. Fifteen to nineteen days later it comes out as a moth (Fig. 22, *a*). The pupa is shining reddish brown, growing darker with age. It is about an inch long, slightly pointed at one end and rounded at the other. The moth measures about one and three quarter inches across the expanded wings. The fore wings are brownish, mottled with black or gray, the shades and markings varying considerably. The hind wings are nearly uniform grayish or pale brownish, with a darker border. Like the larva, the moth is nocturnal in habit, and the eggs are laid at night. The adult may live a week or more, but rarely lasts more than ten days. The complete life cycle in summer requires 45 to 54 days, but in winter, in greenhouses, the period is much longer. Out-of-doors there are two generations in a year, and in greenhouses probably four or more. According to various writers the winter may be passed outdoors in either the pupal, larval, or adult stage.

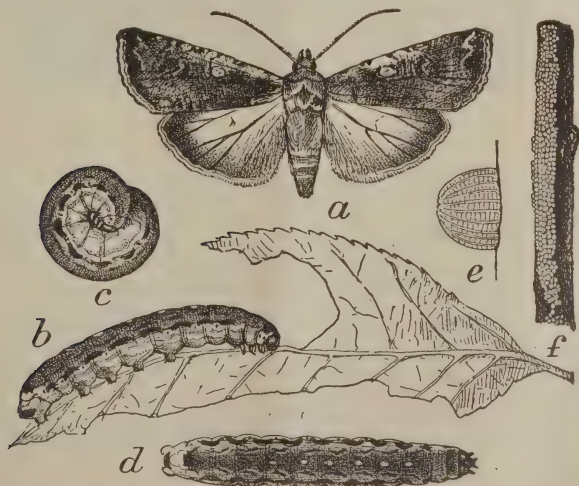


Fig. 22—Variegated Cutworm, *Peridroma margaritosa*: *a*, adult; *b*, larva, side view; *c*, same curled up; *d*, dark-colored larva, seen from above; *e*, single egg; *f*, cluster of eggs on twig. All natural size except egg.

Natural Enemies—A single tachinid fly (*Archytes aterrima* Desv.)* has been bred from this cutworm in Illinois, but three species of these flies and several hymenopterous parasites have been reported to infest it elsewhere. None of these, however, is of much importance in lessening its numbers.

Remedial Measures—In the greenhouse, for such vegetables as lettuce, insecticides may best be used in the form of a poisoned bait. Successful experiments against cutworms were made by me in a Chicago greenhouse this year (1908) with both poisoned bran and poisoned lettuce leaves. In lettuce houses the latter will usually be the most convenient. If the soil is new, and especially if it is a sod soil, lettuce leaves should be laid on the beds and dry Paris green sprinkled lightly over them before the crop is planted. Or if the lettuce has already been planted, it should be pulled up if cutworms are abundant, and a row of lettuce leaves should be laid along each side or in the center of the bed, and then poisoned. Even though there are but very few cutworms in the greenhouse, it is always best to repeat this process at the final gathering of each crop. It is but little trouble to lay fresh refuse leaves along the bed and sprinkle them with the poison.

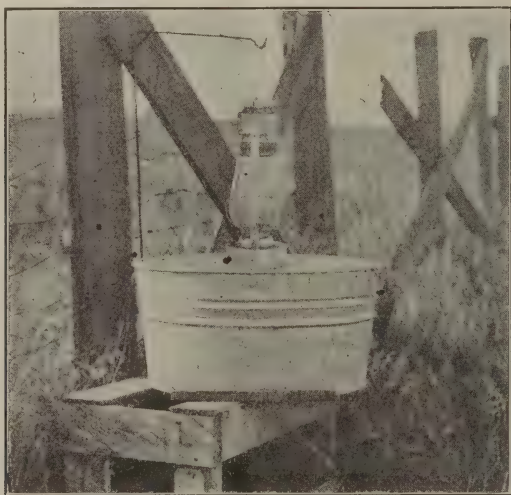


Fig. 23—Trap lantern for adults of cutworm.

A lantern trap (Fig. 23) is also useful in the greenhouse. This consists of a tub with an inch or two of water in the bottom and a little kerosene to form a surface film, and a lantern is hung over the tub to be kept burning for several nights. The moths are attracted by the light, and in flying around it drop into the tub and are killed by the oil.

Outdoor plants, such as cabbages, beets and onions, may be protected by the use of poisoned bran mash, the formula for which is given on page 260. This should be placed in small piles, about a tablespoonful to a pile, at the bases of the plants. When a field which has been in grass is to be planted to vegetables, it is well to use the poisoned bran in spring, shortly before planting the crop.

Dusting or spraying plants with Paris green or arsenate of lead is effective against cutworms and safe for most vegetables, but not for lettuce.

*Determined by C. A. Hart.

It is often easier to pick, brush, or shake off cutworms than to destroy them by poison.

In agricultural practice, early fall plowing is often helpful if done while cutworms are still actively feeding. Their food being thus destroyed, many will starve, and others will be too weak to survive the winter. On the other hand, if the plowing is delayed until the cutworms have pupated, little or no benefit will follow. Crop rotation may sometimes be useful, but as very few garden plants are unmolested by cutworms, it is not to be relied on. Nevertheless, if it can be avoided the more succulent plants should not be grown in soil known to be infested by cutworms.

Clean culture is, of course, important. Weeds and rubbish afford excellent breeding places for cutworms as well as for many other insects.

THE LETTUCE PLANT-LOUSE.

Macrosiphum lactucae Kalt. (*Nectarophora lactucae*, *Siphonophora lactucae*, *Aphis lactucae*).

The lettuce-louse is probably to be found in every Illinois greenhouse where lettuce is grown. It often becomes very abundant, especially in the lettuce heads, and not only stunts the plants, but makes the product unsalable because it is impossible to free the heads thoroughly from the lice. I have also found this louse on celery out-of-doors, but never sufficiently abundant to do injury.

Its life history is the same as that of most other plant-lice; that is, the viviparous female reproduces without the intervention of the male, and gives birth to living young. Each louse may produce 50 to 100 young, and because of this great reproductive capacity a greenhouse may be almost overrun before the presence of the insects has been noticed.

Natural Enemies.—Fortunately, this species, like most plant-lice, is subject to the attacks of many parasitic and predaceous insects which do much to control it. They are seldom capable of holding it completely in check, however, and remedial measures must be resorted to.

Remedies.—Only remedies to be used in greenhouses need be mentioned, as this louse has not been found by us of economic importance elsewhere.

Fumigation is the only satisfactory remedy. The lice are usually within the heads, making it almost impossible to reach them with a spray; and at any rate the use of an effective spray would probably spoil the lettuce for the market. Tobacco or one of the tobacco extracts, or, better, hydrocyanic acid gas, may be used as a fumigant. The latter is the more effective, and will also destroy the white-fly and the aphids of the cucumber, which plant is usually grown in the same houses with lettuce.

THE IMPORTED CABBAGE-WORM.

Pontia rapae Linn. (*Pieris rapae*).

Occasionally the cabbage-worm becomes abundant and destructive to greenhouse lettuce, and I have seen beds which were planted the last part of August or the first part of September completely ruined by it. It has been already sufficiently discussed as one of the cabbage insects (pages 220-222).

Methods of Control.—As arsenicals cannot be used, on lettuce, it is hardly probable that the cabbage-worm in greenhouses can be successfully treated by any of the measures advised for its control out-of-doors (pages 221-222). If there are cabbage gardens near a greenhouse, it is not advisable to plant lettuce until the middle or last of September. If, in spite of precautions, a bed becomes badly infested, the plants should be thoroughly sprayed with Paris green, and pulled up within two or three days, after which the bed may be replanted.

ONION.

With the possible exception of the potato, the onion is the most important garden product of Illinois and its insect enemies are the most difficult to control. In 1899, 2,563 acres were used for the growing of onions in this State, and the acreage has enormously increased since then. There are but two onion pests which are of general economic interest, the onion-maggot and the onion thrips.

THE ONION-MAGGOT.

Phorbia ceparum Meigen. (*Pegomyia cepetorum*, *P. ceparum*, *Anthomyia ceparum*).

Any one who has ever had anything to do with onion-growing is fully aware of the great damage done by the onion-maggot (Fig. 26). As soon as the plant begins to sprout, the work of the maggot begins, and it is at this time that much of the damage is done, although it is not so evident then as later.



Fig. 24—Onion Maggot, *Phorbia ceparum*, female and head of male. Length of body about three-sixteenths of an inch.

Much of the trouble attributed to poor seed is really due to the maggot, which may attack and quickly kill the plants just as they appear above ground, or even sooner. The earlier the attack the greater the number of plants destroyed, since more will be eaten by the maggot.

The adult (Fig. 24) of this maggot is very similar to the common housefly in general appearance, except that it has a grayish thorax and is somewhat smaller. It is a near relative of the cabbage root-maggot, already described, and the two insects, as well as their work, are much alike. The winter may be passed in any one of its various stages excepting the egg. Hibernating adults, or adults maturing early in spring, deposit eggs deep in the cracks and crevices of the earth, near the young plants. The minute maggots hatching two to four days later, more or less according to the prevailing temperatures, make their way to the bulb and begin feeding on

the roots and the underground parts of the plant. They burrow within the bulb, causing the inner parts to decay. An infested onion may appear sound, but by pressure the rotten parts and the maggots may be forced out. When full grown, some two or three weeks after hatching, the maggots change to brownish oval puparia (Fig. 25) in the bulbs or in the earth not far from the onions in which they have been feeding. These puparia transform to adult flies in about two weeks, and the flies, in turn, deposit eggs for a second generation.



Fig. 25—Onion Maggot, *Phorbia ceparum*, puparium. Length about one-fourth inch.

Natural Enemies—The onion-maggot has a few parasitic enemies, but they are seldom numerous enough to hold it in check, and have little economic value in Illinois. Chickens and other domestic fowls are fond of this insect, but on a large onion farm, it would be too difficult and expensive to keep enough of them to be of much assistance.

Methods of Control—As this insect often lives over the winter as a maggot or as a puparium in the onion bulb, it is of great importance that the fields should be thoroughly cleaned up in fall, no onions being allowed to remain there over winter.

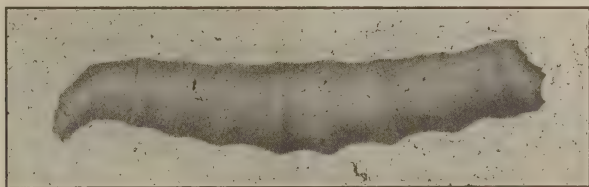


Fig. 26—Onion Maggot, *Phorbia ceparum*, larva, side view. Length about five-sixteenths of an inch.

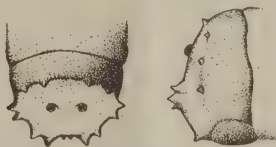


Fig. 27—Onion Maggot, *Phorbia ceparum*, tip of larva, top and side views. Greatly magnified.

As a rule, this pest is more abundant and destructive on comparatively sheltered areas than in open fields over which the winds have full play. This fact should be borne in mind in locating onion beds.

The amount and kinds of manure used may have an important influence on the damage done by this insect. Prof. C. G. Hewitt, of the University of

Manchester, England, has recently shown* that *Anthomyia radicum*, a European species very closely related to the onion-maggot, breeds freely in horse manure. It has often been noticed by entomologists and gardeners that fields which have been abundantly manured are worse infested than those where little manure has been used.†

It is much easier to keep these maggots from infesting onions than to kill them after their appearance. The three best repellents and preventives which have been recommended from time to time are hellebore, tobacco dust and dry lime. The first two are discussed under remedies for the cabbage root-maggot, (pages 224 and 225) and on pages 259 and 260. Dry lime may be applied in the same manner as tobacco dust. These substances either repel the fly or prevent the maggot from reaching the plant even though the eggs are deposited. They should be applied about the time the plants are sprouting or just as they appear above ground.

After plants have become infested it is often possible to kill the maggots before they enter the bulb by applying a contact insecticide. Carbolic acid emulsion and a decoction of hellebore (page 259) have given the best results. They should be applied as soon as the maggots are noticed, or at least before they enter the bulbs, otherwise it is impossible to reach them with any insecticide.

Old onions may be used as traps for the maggots, by placing them along the edges of the field in small piles in early spring, before the onion seed has been planted. The flies will be attracted to these decaying onions, which should be destroyed after infestation, particular care being taken to do this before any of the maggots have become adults.

Mr. F. A. Serrine§ suggests the following hand method: "To get at the onion maggot after the eggs have been laid, carefully lift all the infested onions and destroy the maggots by crushing or by dipping in kerosene. If this is done early in the season, when their work is first noticed, it will be no more of a task than the process of first weeding."

The use of commercial fertilizers, to force the plants rapidly at first, will greatly lessen the amount of injury by the maggot.

THE ONION THRIPS.

Thrips tabaci Lind.

In July or August one sometimes sees whitened onion plants in numbers sufficient to give the entire field a hoary look. This "white blast," as it is often called, is due to a tiny winged insect, the thrips of the onion, sometimes incorrectly called the "onion-louse," which often appears in great numbers,

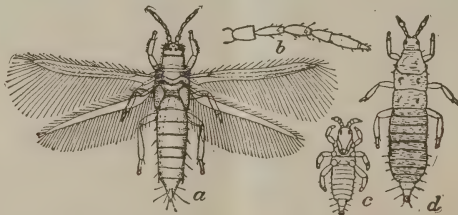


Fig. 28—Onion Thrips, *Thrips tabaci*: a, adult; b, antenna of same; c, young larva; d, full grown larva. All highly magnified.

feeding first at the axils of the leaves. It does not actually eat the leaves, for its mouth parts, which form an inverted cone projecting from the under side of the head, are not of the true biting type. It pierces the epidermis of

*On the Life-history of the Root-Maggot, *Anthomyia radicum* Meigen, Jour. Econ. Biol., Vol. II, Pt. 2 (Aug. 31, 1907), p. 57; and on the Bionomics of certain Calyptrate Muscidae and their Economic Significance, with especial Reference to Flies inhabiting Houses. Ibid, Pt. 3 (Dec. 11, 1907), pp. 86-87.

†For tests with "blood and bone" see page 17.

§Maggots and Smut in Onions. Rural New Yorker, May 12, 1900, Vol. 59, p. 334.

the leaf, and by moving the tip of the cone backward and forward it makes an opening, through which it sucks the juices of the plant. Since this thrips is a general feeder, attacking many cultivated plants as well as weeds, it is of great economic importance, not only to the truck gardener but to the florist also. It is often injurious to cabbage and to cucumber plants in greenhouses.

Its eggs are deposited just within the leaf tissue. The young (Fig. 29, c) are very minute at hatching, elongate, and pale yellowish. The adults (Fig. 29, a) closely resemble the young in shape, but differ by their darker color, and usually by the possession of wings. There are several generations a year, the number varying according to the season. The winter is passed in either the larval or the adult stage.

Natural Checks—The insect enemies of this thrips are of no importance, but the character of the weather has a noticeable influence on its abundance, wet weather being decidedly to its disadvantage.

Remedial Measures—The standard insecticides for thrips are kerosene emulsion and whale-oil soap. Spraying must begin at the first appearance of the insects, and must be repeated in a week or ten days. The most effective indoor remedies are thorough and frequent fumigation with tobacco and tobacco extracts, or with hydrocyanic acid gas.

Clean culture is very important, since thrips hibernate on weeds and grasses along the edge of the onion fields. By plowing up all weedy and grassy land late in fall, after the thrips have left the onions, or by thoroughly burning over such land during the winter, the number of thrips can be greatly diminished. Entire communities should practice these farming methods, for otherwise fields properly cared for may become reinfested from those neglected.

GARDEN PEAS.



Fig. 29—Pea-louse, *Macrosiphum pisi*, on stems of red clover. Natural size.

Garden peas are grown to a considerable extent by many of the market gardeners, and one insect pest, the pea-louse, has been found to do great injury to this crop in Illinois.

THE PEA-LOUSE.

Macrosiphum pisi Kalt. (*Nectarophora destructor*, *Siphonophora pisi*, *Aphis pisi*).

This plant-louse (Fig. 29) is common in all parts of the United States, and is a pest of some importance in Europe, its original home. Its life history is not unlike that of plant-lice already described. The adult is about

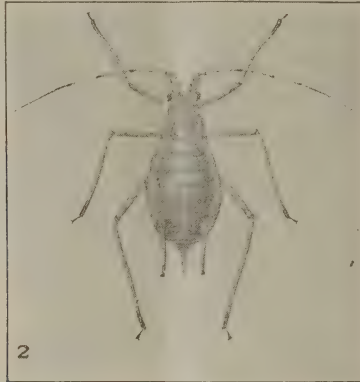


Fig. 30—Pea-louse, *Macrosiphum pisi*, wingless viviparous female. Greatly magnified.

the size of a pin-head, or a little larger, pale green, and soft. It may be winged (Fig. 31) or wingless (Fig. 30). The winter is passed either in the egg or the adult stage, and usually on clover, from which it migrates to the pea in spring, sometimes multiplying enormously on this crop.



Fig. 31—Pea-louse, *Macrosiphum pisi*, winged viviparous female. Greatly magnified.

Natural Enemies—Many parasitic and predaceous insects prey on the pea-louse and materially aid in checking its rapid multiplication, the parasites not infrequently becoming numerous enough to control it completely. (Fig. 32.)

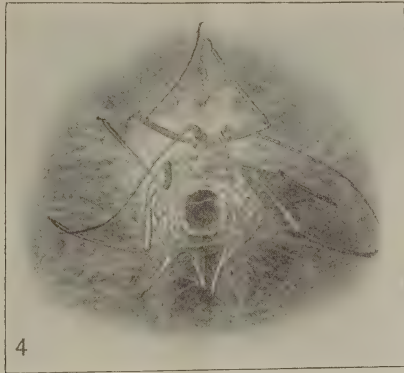


Fig. 32—Pea-louse, *Macrosiphum pisi*, empty skin after the emergence of a winged parasite. Greatly magnified.

Remedial Measures—Sprays of kerosene emulsion or whale-oil soap solution are probably the best remedies known. They should be applied at the first appearance of the lice, and continued as needed.



Fig. 33—Pea-louse, *Macrosiphum pisi*, attacked by fungus. Greatly magnified.

The brush and cultivator method is also much used. With this in view the peas must be planted in rows at least two feet apart. As soon as the lice infest the vines, and at intervals subsequently, they are brushed from the vines and covered by a cultivator before they can get back. Brooms made of fresh-cut pine branches have been suggested for brushing the lice from the vines.

POTATO.

The potato is the most important vegetable grown in Illinois, both in acreage and value of the crop. Though it is attacked by a number of insect pests, none are of much economic importance in this State except the Colorado potato-beetle, the wireworms, the flea-beetles, and the potato plant-louse. The stalk-borer (*Papaipema nitela*) is also occasionally injurious to this crop. For a discussion of this insect see pages 254-255.

THE COLORADO POTATO-BEETLE.

Leptinotarsa 10-lineata Say. (*Doryphora 10-lineata*.)

This common and injurious species has doubtless caused greater damage to potatoes in Illinois than any other insect, and it is found on the vines in destructive numbers every year. It is a western species, its original habitat being the Rocky mountain region. Its native food consisted of wild plants closely related to the potato, and when potato-culture reached its native prairies it promptly availed itself of the increased food supply thus afforded. It began its migration eastward by way of the potato fields about the year 1860, reaching Illinois some fifteen years later. Except in the Pacific coast region, it is now found generally distributed throughout the United States and Canada, wherever the potato is grown.



Fig. 34—Potato Beetle, *Leptinotarsa 10-lineata*: a, eggs; b, larvæ, young and full-grown; c, pupa; d, adults; e, wing-cover of adult; f, hind leg of adult. Natural size except e and f.

The yellow and black striped beetle (Fig. 34, d, d) passes the winter in the ground, and makes its appearance early in spring. It feeds at first on the young potato plants if these are at once available, or, if not, on some one of its wild food-plants. The sexes soon mate, and the clusters of bright yellowish-orange eggs (Fig. 34, a, a) are deposited on the under side of the leaves. Each cluster may contain from 25 to 75 eggs, or even more, and individual beetles have been known to lay as many as 3,000 eggs under certain artificial conditions. The average number, however, is about 450.* The fleshy, grub-like larvæ (Fig. 34, b, b, b) hatch in four to seven days and at once begin to eat the potato leaves. They are dark red when hatched, but gradually become paler as they grow, with two rows of blackish spots along each side of the body. When two or three weeks old they go into the

*Further Biological Notes on the Colorado Potato-beetle, *Leptinotarsa decemlineata* (Say), by Alec. Arsène Girault. Annals Ent. Soc. America, Vol. I, No. 2 (June, 1908), p. 158. Columbus, Ohio.

ground for pupation, emerging as beetles one or two weeks later. These beetles may feed and then go into hibernation, or eggs may be deposited for another generation. The number of generations is still in dispute, but there is probably but one as a rule, only a few of the beetles first to emerge laying eggs for a second generation the same year.

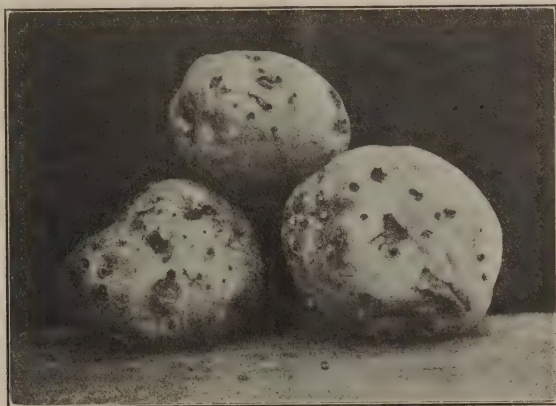


Fig. 35—Potatoes showing injury by wire worms, *Limonius confusus*.

Natural Enemies—Insects enemies of the potato-beetle are not uncommon, but it is doubtful if in Illinois they ever play any considerable role in reducing its numbers. Its commonest parasite in the vicinity of Chicago was a Tachina fly—*Phorocera rufilabris* V. d. W.* The white eggs of this fly were common on the backs of both beetles and larvæ—on the thoracic plate of the adult, and between the thoracic segments of the larva. The maggots hatching from these eggs enter the bodies of the beetles or the larvæ, soon killing them. Many predaceous enemies are known, including soldier-bugs, robber-flies, spiders, ground-beetles, ladybirds, tiger-beetles, rove-beetles, and some native birds and the domestic fowls.

Methods of Control—The two standard remedies for injuries by this pest are Paris green and arsenate of lead. In Illinois, dry Paris green, with or without lime or flour, is used by nearly all potato growers. It has the advantage of being easy to prepare and apply, but there are offsetting disadvantages which make it less desirable than Paris green in water. It is less adhesive than the fluid spray, and hence must be applied more frequently and more labor is required. The dry poison is very injurious when breathed into the lungs by the person applying it. Bordeaux mixture should always be added to Paris green when it is applied in water—as also to the arsenate of lead—for this compound spray is more effective against flea-beetles, and is a remedy for blight. Furthermore, the lime in the Bordeaux unites with the Paris green, thus increasing its adhesiveness, and it changes the soluble arsenic to insoluble, thus preventing the burning of the foliage which often follows when Paris green is used alone. The method of preparation is given on page 60. The potato patch, and indeed the entire farm, should be kept free from weeds of the nightshade family, for the potato-beetle can breed on these.

*Determined by C. A. Hart.

WIREWORMS.

Limoniuss confusus Lec.

But one kind of wireworm has been found by us common enough in Cook county to require special mention, but this single species is very injurious there to potatoes (Fig. 35, 36), radishes, onions, turnips, tomatoes, cabbage, corn, and horseradish. It burrows into or devours the roots and tubers of these vegetables, thus often completely ruining the crop. With the exception of the onion, tomatoes, cabbage, and corn, the plants above mentioned give no evidence above ground of the presence of wireworms, their attacks seldom weakening the plant, but merely disfiguring the marketable part.

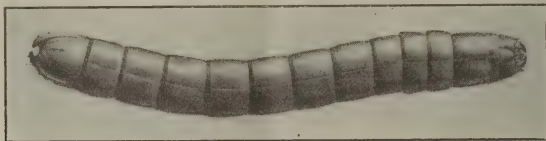


Fig. 36—Wireworm, *Limoniuss confusus*, larva. Length about three-fourths inch.

Remedial Measures—Three methods of control are practiced: rotation of crops, fall plowing, and poisoned baits. Cropping for two years with some vegetable which is virtually immune, such as beans, peas, spinach, cucumber, melon, rhubarb, lettuce, or pepper, should rid the soil of wireworms.*

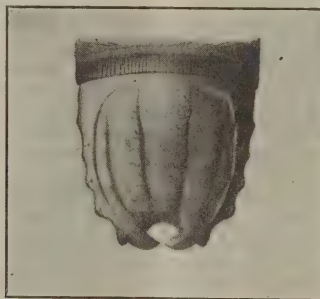


Fig. 37—Wireworm, *Limoniuss confusus*, tip of larva, seen from above. Greatly magnified.

Late summer or fall plowing is frequently resorted to in order to destroy the pupæ and beetles. The land should be cultivated thoroughly several times in the fall.

*This list is given on the authority of those who have reported these plants to be practically uninjured by wireworms, even when the latter are present in the soil.

Trapping the adults by poisoned baits is a method sometimes used in the eastern states. Sliced potatoes, wads of green clover, or corn-meal dough, poisoned with Paris green, have been found effective.*

These baits should be placed under boards in various parts of the field, and renewed once or twice a week during the spring and early summer.



Fig. 38—Wireworm, *Limonius confusus*, adult beetle. Length about three-sixteenths inch.

THE POTATO FLEA-BEETLE.

Epitrix cucumeris Harr. (*Crepidodera cucumeris* Harr.)

Potato leaves are often riddled with small holes as if they had been the target for a discharge of shot. Such injury is the work of flea-beetles. The life history and habits of the potato flea-beetle (Fig. 39) are essentially the same as those of the cabbage flea-beetle, which is discussed on pages 227-228.



Fig. 39—Potato Flea-beetle, *Epitrix cucumeris*, adult. Enlarged as indicated.

Remedies—The best remedy is spraying with Paris green, or arsenate of lead, and Bordeaux mixture, as recommended for the potato-beetle (page

*Our own experiments the past year with poisoned baits for this insect were not sufficiently effective to pay for the labor and materials.

250). Potatoes may be thus protected against the potato-beetle, the flea-beetle, and the blight. Other remedies applicable to this pest may be found on pages 227-228.

THE POTATO PLANT-LOUSE.

Macrosiphum solanifolii Ashm. (*Nectarophora solanifolii*, *Siphonophora solanifolii*).

The potato plant-louse is often a very troublesome species, densely infesting the tops of the plants and soon stunting or even killing them. It is so much like the notorious and destructive pea-louse that the two species cannot be distinguished without a closer examination than the ordinary observer is likely to make. Although commonly pale greenish, there is a red variety of this species which, during the summer, is often as abundant as the commoner green form. The life history and natural enemies of this aphid are similar to those of other plant-lice already described.

Remedial Measures—The only available remedies are those suggested for other plant-lice; namely, kerosene emulsion and soap solutions (pages 258 and 259).

Clean culture seems to be of much importance, inasmuch as the eggs are deposited in fall on shepherd's-purse and possibly on various other weeds.*

Fall plowing and burning over grassy and weedy areas in the neighborhood of potato fields are certainly to be recommended; and Miss Patch further commends, as a precaution, the practice of burning old potato stalks, since belated specimens of the plant-lice may possibly remain on them under certain conditions.

SPINACH.

Spinach is often attacked in fall by a plant-louse which sometimes destroys entire fields.

THE OMNIVOROUS PLANT-LOUSE.

Myzus persicae Sulz. (*Rhopalosiphum dianthi*, *Aphis dianthi*.)

In the fall of 1908 my attention was attracted to the great abundance of a plant-louse infesting spinach on many truck farms near Chicago. This louse may feed on almost any plant, as the common name above given implies. Among the vegetables which it sometimes injures, weakening the plants and causing a curling of the leaves, are turnip, radish, celery, cabbage and cauliflower. It is impracticable to wash off these green lice after they become abundant, and the presence of thousands of them on the spinach renders it unsalable.

Remedies—The only practicable remedy is thorough spraying with a contact insecticide which will not give a permanent odor or taste to the leaves. The standard tobacco or nicotine extracts (page 260) answer the purpose. It is very important that spinach should be closely watched, and that the plants be sprayed at the first appearance of the lice. The treatment should be repeated at intervals as may be necessary.

TOMATO.

Although not extensively grown in the truck-gardens of Cook county, the tomato is of much importance in other parts of the State, particularly as supplied to canneries. A stalk-borer (*Papaipema nitela*) is the principal insect enemy of the crop in Cook county, and is no doubt the cause of more damage than is commonly charged to it. To the casual observer there is no indication of the presence of these insects when the plants wilt and die from

*According to Miss Edith M. Patch. See "The Potato Plant Louse." Bull. Maine Agr. Exper. Station, No. 147 (Nov., 1907), pp. 247-248. Orono, Me.

its attack, and as a rule the gardener is at a loss to find the cause, the characteristic round hole in the stalk being easily overlooked. Occasionally the Colorado potato-beetle, treated on pages 249-250, damages tomatoes soon after transplanting to the field.

THE STALK-BORER.

Papaipema nitela Guen. (*Hydroecia nitela*, *Gortyna nitela*.)

This borer, or "heart worm," as it is often called by corn growers, was found destructive to tomato and corn, and occasionally to potato, in a number of restricted areas during the past year. Other vegetables known to be injured by it are rhubarb, spinach, cauliflower, eggplant, and pepper.

The presence of this caterpillar in the tomato plant is indicated by the wilting or death and final breaking down of the top, and by the presence of a round hole in the side of the stalk, from which a brownish excrement is

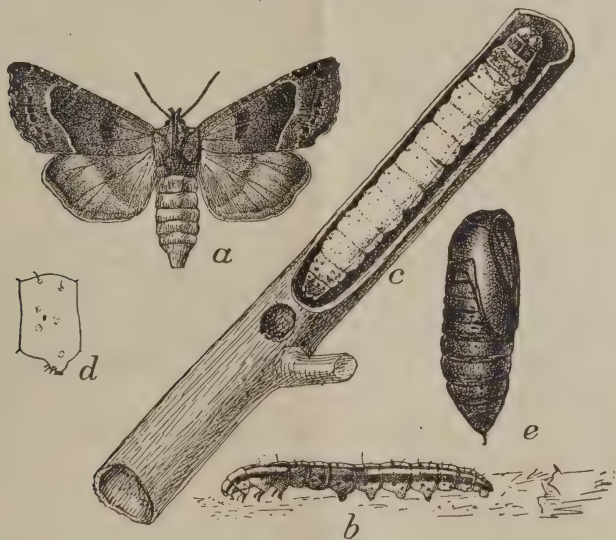


Fig. 40—Stalk-borer, *Papaipema nitela*: *a*, adult; *b*, half-grown larva; *c*, mature larva in burrow; *d*, side of one of its segments; *e*, pupa. Slightly enlarged.

oozing. Upon careful examination of plants so injured a peculiarly striped larva (Fig. 40, *b*) will usually be found in the stalk. The following description is quoted from Professor Forbes.*

The larva may be readily recognized "by the peculiar break in the striping of the body at the middle * * * (Fig. 40, *b*) giving it an appearance as if it had been pinched or injured there. It is about an inch long when full grown. The general color varies from purplish brown to whitish brown, according to age, and it is marked with five white stripes, one running down the middle of the back, and two on each side * * *. The stripes nearly vanish as the larva matures (Fig. 40, *c*). The head and top of the neck, and the leathery anal shield at the opposite end of the body are light reddish yellow with a black stripe on each side."

The young caterpillar first feeds within the stems of grasses or weeds, but as it becomes larger it is compelled to seek thicker-stem plants, and it

*Twenty-third Rep. State Ent. Ill., pp. 44, 45.

is at this time that it begins to infest garden vegetables. In northern Illinois, in 1908, half grown larvæ were found in tomato stalks the middle of June, when fully half the plants in the field had been killed by them. The larva usually enters the stem near the base and burrows upwards. When full grown it changes into a reddish brown pupa (Fig. 40, *c*) within the stalk, usually below the original entrance hole, and later the grayish moth (Fig. 40, *a*) emerges. According to Prof. F. L. Washburn* the eggs of this moth are deposited in masses on the stem of the plant near its base. It is supposed that they are laid in grass lands in fall, and that they hatch the same season or the following spring.

Economic Procedure—After plants have become infested, no remedy can be used to save those individual plants, and they should be pulled up and burned immediately to prevent the larvæ from entering other plants, and also to decrease the number of the borers for the next year.

In spring, vegetation around tomato, potato, and corn fields should be watched, and if it is wilting or dying it should be examined to learn if this borer is present, in which case the weeds should be cut and destroyed without delay.

Late fall plowing of infested fields is advised in order to bury the eggs, which, as already said, are supposed to be laid in grass or weedy land in fall, and all weeds, not only in the fields but along the roadsides adjoining them, should be destroyed at this time.

PREPARATION OF INSECTICIDES FOR USE AGAINST INSECTS INJURIOUS TO GARDEN AND HOTHOUSE VEGETABLES.

From the economic point of view insects are divisible into two classes; those which chew and swallow the tissues of the plant, and those which suck their juices. Insects of the first class—cabbage-worms, potato-beetles, and cutworms, for example—can usually be destroyed by one of the so-called stomach poisons enumerated below; but those of the second class—plant-lice, thrips, the white-fly, etc.—are unharmed by such insecticides because they take their food from the interior of the plant, and so a contact insecticide must be used.

The classification in the following synoptical list of insecticides is based on their most obvious distinctions, and the subsequent treatment corresponds to the order of the list.

Dust or Liquid Sprays

Stomach poisons—for biting insects.		PAGE.
Paris green, dry, with or without an adulterant	256	
Paris green, liquid spray	256	
Arsenate of lead	256	
Resin-lime mixture, with a poison	256	
Bordeaux mixture, with a poison	257	
Contact insecticides—for sucking insects		
Kerosene emulsion	258	
Whale-oil soap solution	259	
Carbolic acid emulsion	259	
Hellebore decoction	259	
Insect powder (pyrethum or buhach)	259	
Tobacco and nicotine preparations	260	
Lye-sulphur wash	260	

Poisoned Baits—for biting insects

Poisoned bran mash	260
Poisoned lettuce or clover leaves	260

*Preliminary Report upon Work with the Stalk Borers in Minnesota. 12th Rep. State Ent. Minn., p. 151, Dec., 1908.

<i>Repellants</i> —for any insects	PAGE.
Carbolic acid and lime	260
Tobacco dust	260
Lime, dry	261
Bordeaux mixture	257
<i>Fumigants</i> —for any insects	
Hydrocyanic acid gas	261
Carbon bisulfid	262
Sulphur	263
Tobacco stems	263
Nicotine preparations	263

PARIS GREEN—DRY.

Unmixed Paris green may be sprinkled upon plants, but the danger of burning the leaves is lessened by adulterating it with flour, land-plaster, or air-slacked lime in the proportion of one pound of the poison to twenty-five pounds of flour or to fifty pounds of land-plaster or lime.

Apply thoroughly and evenly with a hand "dust-sprayer" early in the morning, when the dew is on the plants.

PARIS GREEN—LIQUID SPRAY.

Formula.

Paris green	1 pound
Unslaked lime	1½ pounds
Water	150 gallons

Slake the lime and add the Paris green, thoroughly mixing before adding the water. The mixture must be kept well stirred while it is being sprayed, and most spray-pumps have an attachment for this purpose. The liquid spray is safer and more efficient than either of the dry mixtures previously mentioned.

ARSENATE OF LEAD.

Arsenate of lead can be made by properly combining lead acetate and arsenate of soda, but it is difficult to make a good grade of it, and unless large quantities are needed it is best to purchase standard brands, which are ready for use when dissolved in water.

The price of arsenate of lead is less than that of Paris green, but as one must use two to three times as much of it to secure a desired result, it is slightly more expensive as an insecticide than Paris green. This fact is offset, however, by the following advantages which arsenate of lead has over all other arsenicals: it is much more adhesive, remaining on the foliage for a period during which two or three sprayings with Paris green would be necessary; it remains in suspension better; it shows on the foliage; and it is harmless to vegetation, this last fact being of special advantage when the more tender plants are sprayed.

Care should be taken to obtain a good grade, for there are many worthless brands on the market. Usually a good grade can be obtained from any reliable wholesale druggist. As the strengths of the various brands differ, the gardener should follow the directions accompanying the arsenate he is to use.

RESIN-LIME MIXTURE.

The resin-lime mixture serves as a stock solution to which poisons may be added. It is valuable chiefly because of its adhesive properties, being for this reason well suited to smooth leaves, such as those of the cabbage. It has the disadvantage, however, that considerable time is necessary for its preparation, and that it is especially liable to clog the spray-nozzle. It is prepared as follows:

Stock Solution.

Pulverized resin	5 pounds
Concentrated lye	1 pound
Fish oil, or any animal oil except tallow	1 pint
Water	5 gallons

Place the resin, oil, and a gallon of hot water in an iron kettle and heat until the resin is softened, after which the lye should be added to the heated mixture and the whole thoroughly stirred. Then add the remaining four gallons of water and boil for about two hours, or until it will unite with cold water and make a clear, amber-colored liquid. If there is less than five gallons of the preparation, add water enough to make that quantity. This stock solution will keep indefinitely, and the quantity needed for the whole season may be made up at one time.

Preparation for Use.

Stock solution	1 gallon
Water	16 gallons
Milk of lime*	3 gallons
Paris green	$\frac{1}{4}$ pound

First add the water to the stock solution, mixing thoroughly; then add the milk of lime; and, finally, add the Paris green, previously stirred up with water to form a thin paste. The whole mixture must then be thoroughly stirred. This preparation should be made up as needed, for if allowed to stand any considerable time it will settle, and will also gum up the pump valves and the nozzles.

BORDEAUX MIXTURE AND PARIS GREEN.

Bordeaux mixture is primarily a fungicide; but it is also useful as a repellent against some insects, and with Paris green or arsenate of lead it makes an excellent combination spray to be used when both fungi and leaf-eating insects are to be dealt with on the same crop.

Various strengths of the Bordeaux are used by the vegetable gardener according to the plants to be sprayed. Those in commonest use are often conveniently designated as 4:4:50, and 6:6:50. The significance of the figures is evident from the following 4:4:50 formula:

Copper sulphate	4 pounds
Quicklime	4 pounds
Water	50 gallons

For such plants as asparagus, tomatoes, and melons, the 4:4:50 strength is used; and for the potato and related plants, the 6:6:50.

To make the Bordeaux mixture, dissolve the copper sulphate in about 20 gallons of water—best done by placing the sulphate, or bluestone as it is often called, in a gunny sack or other stout cloth bag and suspending it in the water. It will dissolve in a day or so, and if covered to prevent evaporation it will keep indefinitely. If less than 50 gallons of the Bordeaux mixture is needed, or if the solution is wanted immediately, the bluestone may be readily dissolved in hot water.† In another vessel slake the lime, adding the water slowly, to obtain a smooth, creamy liquid, using barely enough water to cover the lime after it has settled. In this condition, if evaporation is prevented, it will, like the copper-sulphate solution, keep indefinitely.

When ready to spray add enough water to each stock solution, separately, to make 25 gallons, stir each thoroughly, and then mix the two together. This may be done by having the barrels containing the two solutions on a

*Milk of lime is made by slaking stone lime and adding sufficient water to make a thin whitewash.

†Copper sulphate, either dry or in solution, corrodes iron, and a wooden, earthen, brass, or copper vessel should be used.

high support, with plugs near the bottom so that both solutions can be run into a third vessel below, the operator stirring the fluids as they unite. Or, if such an apparatus is not obtainable, the mixture may be made by pouring the two fluids together from buckets (Fig. 41).



Fig. 41—Method of preparing Bordeaux mixture by hand.

For the combined fungicide and insecticide, add five or six ounces of Paris green, previously made into a paste with water, to fifty gallons of Bordeaux mixture, and thoroughly stir. If arsenate of lead is used in place of the Paris green, about four or five times as much will be required.

Although the separate solutions of the copper sulphate and of the lime are stable, they are not so when combined, and therefore only the quantity to be used at the time should be made up.

KEROSENE EMULSION.

Stock Solution (66 per cent kerosene).

Soap*		½ pound
Kerosene		2 gallons
Water		1 gallon

If hard soap is used, cut it into fine shavings and dissolve in boiling water, after which remove from the fire and immediately add the kerosene and thoroughly mix. This may be done most easily by churning for about ten minutes with a force-pump, the nozzle being turned back into the liquid; or, in the absence of a pump, the liquid may be turned from one bucket to another for fully ten minutes, holding the bucket high so as to give force to the falling liquid. When thoroughly emulsified it will have the consistency of thick cream, and the oil will not separate out. There is great danger of injuring the plants if the mixture is not well and thoroughly made.

*Either hard or soft soap may be used. Whale-oil soap and "Tak-a-nap" soap have given excellent results.

For spraying vegetation the stock solution should be diluted to the desired strength. For a five per cent emulsion add 37 gallons of water to 39 gallons of the stock solution; for a 10 per cent emulsion add 17 gallons of water to the same; and for a fifteen per cent emulsion add 10½ gallons.

It is desirable to use soft water both for the stock and as a diluent, but if this is not obtainable the water should be softened by adding lye or sal-soda.

The emulsion should be applied to plants with a spray-pump, and in a fine mist-like spray. For most insects a ten per cent emulsion is strong enough.

WHALE-OIL SOAP SOLUTION.

Whale-oil soap is an effective insecticide for plant-lice and other soft-bodied insects. For use, dissolve one pound of the soap in six to eight gallons of hot water.

CARBOLIC ACID EMULSION.

Carbolic acid emulsion is a contact insecticide, and also acts as a repellant, being chiefly used for the treatment of root-infesting insects.

Stock Solution.

Hard soap (preferably "Ivory" or "Tak-a-nap")....	1 pound
Soft water	1 gallon
Crude carbolic acid	1 pint

Dissolve finely shaved soap in boiling water, add the carbolic acid, and churn as for kerosene emulsion. For use, one part of the stock solution is diluted with thirty to forty parts of water.

HELLEBORE DECOCTION.

For use against root-maggots, this decoction is prepared by steeping two ounces of white hellebore in one gallon of hot water for 30 minutes. For insects infesting the foliage, one ounce of hellebore to two gallons of water is sufficient. Hellebore very soon loses its insecticidal properties by exposure to the air, and care should be taken to obtain only such as is known to be fresh.

INSECT POWDER (PYRETHRUM, OR BUHACH).

Pyrethrum, or insect powder, as this insecticide is commonly called, is of special value for killing certain kinds of insects, and it has the advantage of being harmless to human beings and the higher animals. On the other hand, its expense prohibits its use on a commercial scale, and it quickly loses its virtue when exposed to the air. If used in a dry form it should be mixed with twice its weight of common flour, and kept in a tightly closed vessel for 24 hours before using. It may be applied with a dust sprayer or some sifting apparatus. A decoction of pyrethrum may be made by mixing one ounce of the powder with enough water to form a thin paste and allowing it to stand several hours, after which sufficient water should be added to make two gallons. This is less effective than the dry powder.

In purchasing pyrethrum, only hermetically sealed cans of it are safe, for the reason already given, but if they can not be obtained care must be taken to buy only an absolutely fresh article.

TOBACCO DECOCTION AND NICOTINE PREPARATIONS.

Tobacco decoction, although not so effective as some of the above-mentioned contact insecticides, is still used by many for killing soft-bodied insects, such as plant-lice. It is prepared by steeping tobacco stems in hot water at the rate of one pound to two to three gallons.

More reliable than the above, are various commercial preparations which likewise have nicotine as their active principle. (See page 263.)

LYE-SULPHUR WASH.

This contact spray is said to have particular value against the red spider. It is prepared by mixing five pounds of flowers of sulphur with cold water and then adding to this sulphur paste two and a half pounds of pulverized caustic soda. Water is added from time to time, to prevent burning, until a concentrated solution of five gallons is obtained. One gallon of this stock solution is sufficient for 25 gallons of spray.

POISONED BRAN MASH.

Bran	16 pounds
Paris green	1 pound

Slightly dampen the bran and add the Paris green, mixing until every particle of the bran bears some of the poison. The bran should be barely wet enough to make the powder adhere to it, as experiments in green-houses strongly indicate that a soggy mash is not freely eaten by cutworms. A little salt in the water used is said to give the mixture additional relish.

POISONED LETTUCE OR CLOVER LEAVES.

Small lots of lettuce or clover are poisoned with Paris green, either dry or suspended in water, and the poisoned vegetation is then cut or mowed, and scattered over the infested tract (see page 241). This and the poisoned bran mash seem to be about equally effective.

CARBOLIC ACID AND LIME.

A coating of the soil at the base of the plants with carbolic acid and lime has been recommended by Dr. John B. Smith* as "the most effective material tested," in his experiments against the onion-maggot in New Jersey.† To make the mixture, slake three pints of lump lime in a gallon of water, and add one tablespoonful of crude carbolic acid. When applied properly along the rows with a sprinkling-can or spray-nozzle, a thin crust will form on the ground around the plants, which is said to serve the same purpose as the tarred felt-paper protectors described on page 224.

TOBACCO DUST.

Tobacco dust has been recommended as a useful repellant, particularly against such insects as root-maggots and cucumber-beetles. It has the further advantage of serving as a contact insecticide and as an excellent fertilizer. Indeed, it is said that its value as a fertilizer alone is sufficient to cover its cost.

For leaf-eating insects it is dusted on the leaves early in the morning, while the dew is on. For root-feeding insects it is sprinkled along the rows at the base of the plants, preferably when the soil is moist.

*The Cabbage and Onion Maggots. Bull. N. J. Agr. Exper. Station, No. 200 (Feb. 12, 1907), pp. 16-19.

†For reference to our own experience with it see page 224.

DRY LIME.

Fresh air-slaked lime or quicklime when used as a repellant for root-maggots is sprinkled along the rows close about the plants, and acts similarly to the carbolized-lime application. As some insects of economic importance are attracted to manures, the latter should be sprinkled over with lime where there is danger of infestation by insect pests.

Dry lime, especially when fresh, is strongly caustic, and is therefore valuable as a contact insecticide for slugs, plant-lice, and soft-bodied insects generally.

HYDROCYANIC ACID GAS.

Hydrocyanic acid gas is doubtless the most powerful and effective fumigant known. Indeed, many are afraid to handle the deadly gas; but it can be used with perfect safety if proper care be taken.

It is impossible to give a set formula for its use, owing to differences in the structure of greenhouses. In those of average tightness I have used it on cucumber plants, without injury to them, at a strength of 1 ounce of potassium cyanide to 3,000 cubic feet of space—fumigating in the evening, and keeping the house closed over night.

The materials necessary for fumigation with hydrocyanic acid gas are potassium cyanide (98 to 99 per cent pure), commercial sulphuric acid, and water; and the requisite utensils are half-gallon or gallon jars—stone, earthen, or granite—and a supply of ordinary small paper bags.

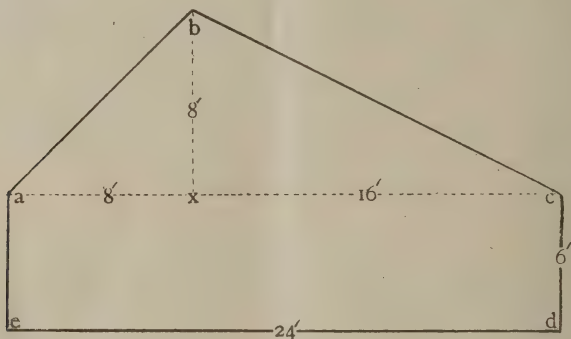


Fig. 42—Diagram illustrating determination of cubic contents of greenhouse.

The number of cubic feet in the house should first be accurately calculated. The method of doing this may be illustrated by a simple computation based on the dimensions given in the accompanying figure, the understanding being that the length of the greenhouse is 100 feet. (Fig. 42.) The cubic contents of the rectangular section of the house, $a c d e$, equals $24 \times 6 \times 100 = 14,400$ cubic feet; that of the triangular section $a b x$, equals $8 \times 8 \times 100 \div 2 = 3,200$ cubic feet; and that of the other triangular section, $b c x$, equals $8 \times 16 \times 100 \div 2 = 6,400$ cubic feet. The cubic contents of this house are, therefore, $14,400 + 3,200 + 6,400 = 24,000$ cubic feet. Assuming this house to be of no more than the average tightness, we may safely use potassium cyanide at the rate of one ounce to every 3,000 cubic feet of space, and 24,000 divided by 3,000 gives 8 as the number of ounces required in this illustrative case.

The next procedure is to prepare the materials for use and to place the jars in the house. For every ounce of the potassium cyanide used, two ounces of sulphuric acid and four ounces of water are required. Two ounces of the cyanide is about the right quantity for each jar, therefore, for a house of the above dimensions four jars should be placed at equal intervals along the aisles, and the eight ounces of cyanide divided into four equal parts,

and each part put into one of the paper bags. These are used not only for convenience in handling the cyanide when placing it in the jars, but also because they slightly delay the action of the sulphuric acid upon it, thus giving the fumigator ample time to leave the house before the reaction occurs. The jars being in place and the cyanide properly weighed and bagged, the next step is to close all the ventilators in order to prevent any avoidable escape of gas. The water—four liquid ounces to every avoirdupois ounce of cyanide—is then placed in each jar, the sulphuric acid—half as much as the water—is added, and as soon after as possible the bags of cyanide should be put into the jars and the house vacated immediately. Doors should be locked and labels posted indicating the danger. No one should enter the house until it has been thoroughly aired by opening the side doors, and, if convenient, the ventilators also. It is best to fumigate in the evening, keeping the house closed till morning. I have never found a greenhouse so tight that the fumes would remain in it in dangerous quantities all night; nevertheless, it is safest to air the house well before entering.

Precautions and Miscellaneous Directions—As cyanide of potassium is a powerful poison it should be handled as little as possible. It should be kept in tightly closed cans or jars, plainly labeled, where it will be inaccessible to persons not acquainted with its poisonous properties. Use only a grade 98 to 99 per cent pure. It may be obtained in either granulated or lump form, the former being the most convenient for use in fumigation.

Sulphuric acid should not come in contact with the hands or with the clothes, as it will severely burn the flesh and ruin the clothes. It should not be placed in metal receptacles, as it will soon eat them through.

Fumigate in the cooler parts of the day, and avoid, if possible, a temperature above 60° or 65° F., since at a higher temperature the plants are more liable to be injured.

The foliage of plants to be fumigated should be perfectly dry, otherwise it will absorb the gas and be burned.

The best shaped jar, when using two ounces of cyanide to a jar is one four or five inches in diameter and about nine inches high. If more cyanide is to be used in each receptacle larger jars must be used.

Always put the water into the jars first, adding the acid later. Never pour water into the undiluted acid.

After placing the sulphuric acid in the jars the bags of cyanide should be put in as soon as possible, for any delay will interfere with the proper reaction of the chemicals owing to the fact that the acid acts most powerfully when it first unites with the water. The manner of putting the bags into the acid is also important. They should not be held a foot or more above the jars and dropped in, as the bags may be thrown out by the reaction. Each bag must be carefully laid in the jar, but the fumigator must not lean over the jar as he does it, nor remain near it to watch the reaction. After a few fumigations the operator often becomes less attentive to the prescribed directions and precautions. This tendency should be promptly checked, the utmost care and caution being uniformly necessary.

CARBON BISULPHID.

Carbon bisulphid is used as a fumigant for aerial plant-lice, for root-lice and root-maggots, and for weevils in seeds. For methods to be followed in treating the first class mentioned, see page 226. For root-lice and root maggots, a small hole is made in the ground near the plant, and into it is poured a small tablespoonful of the liquid. The hole is then promptly closed and the maggots are killed by the fumes. The carbon bisulphid should not be poured on the plant above ground nor directly on the roots. For weevils, the seed should be placed in a tight box or bin, space being left at the top for a pan or other shallow dish for the carbon bisulphid. This should be used at the rate of one ounce to 60 cubic feet of box space, and the box should be kept closed for 24 hours. The vapor given off being heavier than air, descends, killing all insects present without injuring the seed.

As the fluid is inflammable, and its vapor, mixed with air, somewhat explosive, precaution should be taken never to permit a spark of fire to come in contact with it.

Carbon bisulphid may be obtained at drug stores for 20 to 35 cents a pound. A grade known as "Fuma Carbon Bisulphide," which is fully as effective for fumigation as the ordinary grade bought by druggists, is manufactured by E. R. Taylor, Penn Yan, New York, and furnished in 50 or 100-pound cans at 10 cents a pound.

SULPHUR.

Thorough cleaning of greenhouses for the eradication of insect pests should be practiced by the greenhouse gardener when the houses are empty, and fumigating with sulphur is one of the best and easiest means to this end. About one pound of sulphur should be burned to every 2,000 cubic feet of space, after which the house should be kept tightly closed for 24 hours, or longer if convenient. It is needless to say that at this strength all plants, as well as insects, will be killed.

For fumigating houses containing growing plants, evaporate a small quantity of sulphur in a suitable receptacle over a lamp or oil burner, taking care that it does not catch fire; or the steam pipes may be painted with a sulphur paste made by mixing sulphur and water. A paste is sometimes made in which the sulphur is mixed with oil instead of water. Sulphur is not only valuable as an insecticide, but useful in controlling mildew.

TOBACCO STEMS.

Though tobacco stems for fumigation purposes have been largely superseded by the recent introduction of various nicotine extracts, they are still used, and are recommended for killing plant-lice and thrips, especially when easily obtainable at a reasonable price.

Three piles of stems, of about half a bushel each, are used to every 100 linear feet of the house, the piles being dampened to prevent rapid burning. These are set on fire in the evening, when the building is left for the night. The house must be kept as tightly closed as possible until morning. Frequent fumigations—at least weekly—are necessary to obtain the best results.

NICOTINE PREPARATIONS.

Many nicotine preparations are now on the market under such trade names as "Nicoteen," "Nicoticide," "To-ha-ken," "Nico-Fume," etc. Most of them contain 25 to 45 per cent of nicotine, and are more effective, though more costly, than tobacco stems or tobacco dust. They may be used as fumigants in various ways. The commercially prepared fumigating papers are suspended in strips and lighted when ready to fumigate. Dry preparations are placed in shallow dishes and ignited. It is sometimes advisable to add a few drops of kerosene to facilitate their burning. The extracts are evaporated over a lamp, or, like the sulphur paste, are painted on the steam pipes. They evaporate or burn slowly, producing a powerful vapor. As a rule it is best to fumigate in the evening, keeping the houses closed over night. Most insect pests of the greenhouse may be controlled by thorough and oft-repeated fumigations with one of these extracts.

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Illinois Farmers' Institute

CIRCULAR No. 5.



Suggestions for Corn Contests.

(Approved and Adopted by the Illinois Corn Growers' Association, Jan. 25, 1912.)

TEN-EAR, THIRTY-EAR AND BUSHEL BASIS.

AGE CLASSES—Boys, 14 to 16 inclusive. Young Men, 17 to 20 inclusive. Men, 21 and Above.

VARIETY CLASSES—1. All those varieties recognized as standard by the Illinois Corn Growers' Association. 2. General.

1. Local corn shows and all entries and judging of exhibits must be done according to the rules and the score card of the Illinois Corn Growers' Association.

2. All corn shown must be grown by the exhibitor, and must be of the crop of the current season.

3. The territory covered by any special contest should be divided into sections; the larger the area from which the exhibits come, the larger the number of sections necessary.

4. If, for any reason, (i. e., immaturity) at the time of a contest it is impossible to remove the kernels to judge such points on the score card as kernel shape, kernel uniformity, or proportion of grain to ear, the marking on these points shall then be uniformly 80 per cent of the perfect score.

5. It is recommended that the prizes in any given show be widely distributed, a total of not less than five places when possible. A wide distribution of small prizes is preferable to a few large premiums.

6. Localities, towns, clubs, etc., wishing to conduct corn shows under the auspices of the Illinois Corn Growers' Association shall make application to the Secretary of the Association. (Leigh F. Maxcy, Curran, Illinois.)

The Secretary shall see that such a locality, town, or club, is supplied with suggestive rules, score cards, etc., and with such assistance as is desired.

The Executive Committee of the Corn Growers' Association and the standing committee on rules for contests shall assist the secretary whenever called upon.

ACRE BASIS—BOYS CONTESTS.

1. Age limit, 15 to 20 years.

2. The acre used may be any shape most convenient to the grower. It must contain no more or no less than 160 square rods. It must have a border row of corn on each side and each end which shall be the same distance from the first corn row of the acre proper, as is the distance between the rows in the acre.

3. The name and type of seed corn used must be recorded.

4. The planning, and as nearly as possible, all the labor on the acre to be done by the contestant.

5. An account of the time required for each of the various operations should be kept; these include fertilizing, plowing, pulverizing, planting, cultivating, etc., as well as the manner of planting, hills, drills, listing, distance apart of hills, stalks per hill, etc.

6. If fertilizers are used, give kind, amount applied and cost.

7. Final measurement of the area and husking shall be done only under the supervision of the local committee of judges, one of whom shall be a representative of the Illinois Corn Growers' Association.

8. Samples of corn that are representative of the acre shall be taken by the local committee, and the per cent of dry matter determined according to the oil process.

9. The yield per acre shall be calculated to water free corn; this places all contestants on exactly the same basis, and gives every variety of corn used, an equal show.

10. The contest is to be judged by the following score card:

Yield of water free corn	80
Completeness of report of work by contestant	20
Total	100

Note 1. It is the sense of the committee that the above suggestions will lead to useful observation and information that may later be helpful to others and contribute to permanent advancement and welfare while a contest based wholly on yield of corn would fail largely in the object hoped for.

Note 2. Men's corn contests to be conducted under the same rules as above except that age limit is removed.

Note 3. As an assistance in keeping accurate records the secretary of the Illinois Corn Growers' Association will be prepared to furnish the following sheet to all contestants in yield per acre contests:

RECORD SHEETS.

Name Age
 Address
 Where is the farm located?
 What is the character of the surface soil?
 Of the sub-soil?
 What crop was on the land last year?
 What did it yield per acre?
 Give crops and approximate yields from field for five years.
 What kind of plant food have you applied to this land in this time?
 What did they cost?
 What work was done before plowing?
 What tools were used?
 What time was required?
 When was the land plowed?
 What kind of a plow was used?
 What time was required for plowing?
 What work was done after plowing to prepare for planting?
 What tools were used?
 How much time required?
 When was the planting done?
 How much time required?
 What variety of corn was planted?
 What type of the variety?
 Was a germination test made of the corn?
 What was the percentage of germination?
 Was the corn drilled, checked or listed?
 What was the distance between rows?
 Distance between hills?
 How many hills per acre?
 How many stalks per acre?
 When did the first plants appear above ground?
 How many times was the corn cultivated?
 What implements were used?
 Approximate depth of cultivation?
 How much time required for each cultivation?
 When did the first tassels appear?
 The first silks?
 When was the corn husked?
 How many ears were produced on the acre?

It is suggested that contestants make as careful an estimate of the number of ears produced on the acre as possible, and compare this number with the number of stalks growing on the acre.

THE SCORE CARD.

Entry No.

Corn score card to be used in corn judging contests.			Student's Score.		Instructor's Score.		Possible errors.	Student's errors.
			No.	No.	No.	No.		
1	Length of ear.....	10					1	
2	Circumference of ear.....	5					1	
3	Color in grain and cob.....	10					1	
4	Shape of ear.....	10					1	
5	Uniformity of exhibit.....	5					1	
6	Tips of ears.....	5					1	
7	Butts of ears.....	5					1	
8	Kernel uniformity.....	5					1	
9	Kernel shape.....	5					1	
10	Space between rows.....	5					1	
11	Space between kernels at cob.....	5					1	
12	Vitality or seed condition.....	10					1	
13	Trueness to type.....	10					1	
14	Proportion of shelled corn to ear.....	10					2	
	Total.....	100					2	
	Lack of legibility or promptness.....						3	
	Total errors.....						20	
	Student's rating.....							

..... Judge.

Name and address of exhibitor after exhibit has been judged:

.....

RULES FOR RECORDING ERRORS.

(1) If on any one item the student places the samples in the same order as the instructor, no error shall be counted.

(2) If on any one item the student marks the samples alike and the instructor unlike, or the student marks them unlike and the instructor alike, a .5 error shall be counted.

(3) If on any one item the student places samples in the opposite order from the instructor, one error shall be counted.

(4) For each mistake in footing, one error shall be counted.

(5) For illegibility or lack of promptness in doing the work the instructor may, at his discretion, count from one to three errors.

(6) To find the student's rating, subtract his error from the possible errors (20) and find what per cent the difference is, of 20.

(7) If there is a tie, or if several students have the same rating, the first place shall be given to the one whose footings are nearest to the footings of the instructor, and the second place to the one who stands second in this respect, etc.



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Illinois Farmers' Institute

CIRCULAR No. 4—SECOND EDITION

1916



Important Insects of the Truck Gardens of Illinois

General Farm Methods for Control of Insects—
Life History—Prevention—Remedies—
Formulas—Miscellaneous Directions

By

J. J. DAVIS,

Assistant Entomologist for Northern Illinois

(Reprint from Vol. 16, Illinois Farmers' Institute Report, 1911.)



SCHNEPP & BARNES, STATE PRINTERS
SPRINGFIELD, ILL.
1916.

PRELIMINARY REPORT OF THE MORE IMPORTANT INSECTS OF THE TRUCK GARDENS OF ILLINOIS.

[By J. J. Davis, Assistant Entomologist for Northern Illinois.]

Introductory Note—The following paper on the more important insects of the truck farm and vegetable garden was prepared by Mr. John J. Davis while he was in the service of the State Entomologist's office as assistant for northern Illinois. It was planned as an article for the Entomologist's report, but is published in the report of the State Farmers' Institute as a means of giving it earlier and wider circulation among those most immediately interested in its contents. Besides the main results of Mr. Davis' work on this subject for three and a half years, while stationed at Chicago, it contains an abstract of the contents of published papers on its topic.

STEPHEN A. FORBES, *State Entomologist.*

Vegetable gardening is now one of the most important of the various agricultural interests of Illinois. According to the census of 1900 there were 256,213 acres in vegetables in Illinois in 1899, and the value of the products amounted to \$10,346,797.00, this being the fourth largest valuation of such products for all the states. The average valuation of vegetables was \$42.00 per acre, while that of all crops taken together was but \$10.04. Although the gardening industry in Illinois, and especially in Cook County and counties adjoining, has greatly increased since 1899, the figures for that year serve to indicate the relatively great importance of vegetable growing in Illinois.

Chicago is the principal center of the truck garden industry of this State, and for a distance of 12 to 18 miles north, south and west of the city, agriculture is almost wholly gardening. This area is especially well adapted to such farming, as the more or less sandy character of the soil permits early tillage—a very important fact from the truck gardener's point of view, since it enables him to get his products on the market at an early date, while prices are still high. Cook County growers have a market close at hand so that they can personally dispose of their produce, making sales from their own wagons, thus avoiding freight and commission charges. Further, Chicago affords an ample supply of manure for continuous fertilization, which is absolutely necessary where such intensive farming is practiced, and where so much is taken from the soil each year.

Another important consideration is the labor supply; for such crops as onions and cucumbers require large numbers of laborers at certain times of the year, and in isolated localities and in small towns there is usually insufficient help in the busiest parts of the season. In Cook County, however, the city of Chicago can usually furnish all the labor required, and at a cheaper rate than in remote localities.

Probably the most important garden product of Illinois is the potato. The area in this crop in Illinois in 1899 was 139,464 acres, and the estimated value of the product was \$4,702,033. In Cook County alone there were 15,336 acres in potatoes. Onions and cabbage are important crops, as are also asparagus, celery, beets, and that class of vegetables known as general truck, which includes radishes, lettuce, parsnips, carrots, rhubarb, beans, etc. The growing of sweet corn, tomatoes, beans and peas for canning, and of cucumbers for pickling, is becoming a prominent industry, and the same is true of melon growing in many parts of the State. Cucumbers, tomatoes, lettuce and radishes are extensively grown in hothouses, as well as out-of-doors.

The gardening regions are more or less divided into areas, in each of which a certain class of products is cultivated. For example, a strip of ground half a mile or a mile in width may be used for onion culture almost exclusively, or it may be in potatoes or cabbage, or both, or it may be devoted to general gardening.

The more intensive the culture of a crop, the more important becomes the control of its insect enemies. Land is especially desirable for vegetable

gardens near the market centers, and as these are almost invariably large cities, such land has a high value, and the greatest possible returns must be realized from it. To insure this the control of injurious insects becomes of great, if not prime, importance.

GENERAL FARM METHODS FOR CONTROL OF INSECTS.

Clean Culture.—Probably the most valuable of all farm practices for the control of insects is clean culture, by which is meant the clearing away of all useless vegetation, and the numerous other general measures which leave for insects no sufficient winter shelter, or adequate protection from the weather, the birds, and other natural checks upon their numbers. In fall, rubbish of every kind, and especially standing unmarketable cabbages and onions, should be collected and destroyed, to deprive insects of their breeding and hiding places. These methods are particularly helpful in destroying cabbage and onion maggots, cutworms, thrips, plant lice, potato beetles, and striped cucumber beetles. In the summer likewise, and especially early in spring, it is important to keep down the weeds, for they promote a rapid multiplication of insects, and provide temporary breeding places for some species pending the appearance of their special garden food plants. An early cutting of weeds is further beneficial by preventing their seeding.

Importance of Healthy and Vigorous Plants.—It is a common observation that healthy and vigorous plants withstand the attacks of insects much better than weak and neglected ones. One of the principal requirements for vigorous growth is fertility of the soil. Good seed is necessarily an important item, and, further, it should be properly planted and the crop should be thoroughly cultivated to secure strong and healthy plants. Such plants will also endure the effects of drouth for a much longer time than weaker plants.

Rotation of Crops.—Crop rotation is one of the most valuable of the cultural methods for preventing insect attack. As a rule, it is bad practice in truck gardening to grow two successive crops of a vegetable, or of nearly related vegetables, successively, on the same piece of land; and, further, a crop should be planted as far as possible from the location of the same vegetable the year before. Especially is rotation desirable when the crop was badly damaged by insects the previous year. Some of the more important insects whose injuries may be checked or controlled by this method, are cabbage and onion maggots, potato beetles, wireworms, white grubs and cutworms.

Fall Plowing.—Another important means of insect control is fall plowing. In the northern part of Illinois, where the winters are usually severe, the value of this measure seems considerable, for its main object is to bring the insects in the soil nearer to the surface, where they may be killed by the cold. It is necessary in such localities to plow as late in fall as possible, when the insects are more or less inactive and unable to go very deep into the ground. Disking and harrowing in the fall is often helpful.

Time of Planting.—It is often possible to avoid insect attack by either early or late spring planting. The object in planting early is to have the crop well started and sufficiently advanced to withstand insect attack when it occurs; while the object of late planting is to bring the crop on after the disappearance of the insect likely to injure it. I have known of but one instance of such benefit derived from early planting, and this was in the case of the onion maggot. Late spring planting is a successful measure of protection against some insects, such as cutworms, the striped cucumber beetle, fleabeetles, etc.

Early Detection of the Presence of Insect Pests.—Usually an insect has already done much damage to a crop before its presence is known, and often it is discovered too late for the successful application of remedies. This makes it necessary for the gardener to keep vigilant watch of his crops in order to know when to spray or otherwise to treat them; that is to say, he should detect the presence of an injurious insect in his garden almost as soon as it appears.

Insect injury may be recognized by the actual detection of the culprit; by the failure of seed to germinate; by injury to the leaves; by a wilting

of the plants; by the wilting or curling of the leaves, caused by aphid attack; by an uneven stand; or by the slow growth of the plants.

The more important insects known to be injuring garden products in Illinois will now be discussed under the various crops, taken up in alphabetical order. Methods of preparing the principal insecticides used by the gardener are given at the end of the article.

ASPARAGUS.

The area in asparagus has greatly increased in Illinois in the last few years, and the plant is now one of the most important products of several gardening districts. Only one insect—the common asparagus beetle (*Crioceris asparagi* Linn) has been found doing any considerable damage to this crop, and this in only two localities.¹ Where present, however, it is an important pest of this plant, and the increasing acreage in asparagus may cause its spread over a much larger territory. The asparagus grower should be on the continual lookout for it, and at its first appearance take immediate measures for its control.

THE COMMON ASPARAGUS BEETLE.

Crioceris asparagi Linn.

Both beetles and larvæ of this species cause injury by feeding on the young shoots as they appear above ground, and by defoliating the plants later in the season. In the first case the young shoots are rendered unsalable or of poor quality, while the loss of foliage greatly weakens the plants, especially seedlings.

The beetle (Fig. 2, a) is one-sixth to one-fourth of an inch in length, and is gayly colored, the thorax being reddish, and the elytra, or wing covers, more or less striped with lemon yellow and dark blue, and having a reddish border. Early in spring, at the time of the first cutting of asparagus, the beetles emerge from their winter quarters and lay their conspicuous yellowish, slender eggs (Fig. 2, b) end to end, in rows of eight or less, on the stalks or leaves of the asparagus plants. In our experiments a single female, in confinement with a male beetle, laid a total of 386 eggs during her life of 29 days—from May 13 to June 11. In about a week the eggs hatch into "grubs" or larvæ (Fig. 2, c), which immediately begin to feed. These become full-grown (Fig. 2, d) in about two weeks or less, at which time they are a quarter of an inch in length, or slightly shorter, fleshy, and of an olive color. The mature larvæ go into the earth and change to pupæ (Fig. 2, e) just beneath the surface.



Fig. 1—Common Asparagus beetle, *Crioceris asparagi*, larvæ and adults, on asparagus. Natural size.

¹ Since the above was written it has been found in other localities, and it is probably only a matter of a few years until it will become common throughout our asparagus-growing districts.

They remain in this condition nine to twelve days, and then change to beetles, which, in turn, come out of the ground and lay eggs for a second generation. The beetles of this generation go into hibernation in the fall, about the middle of September in ordinary seasons. It is not certain that there are but two broods a year in Illinois; the life history has not been completely worked out for this State, but observations made in northern Illinois indicate that in ordinary seasons from two to three broods occur there. We have succeeded in raising three broods in one season in confinement, under what were probably optimum conditions, in the latitude of Chicago.

Methods of Control.—Volunteer asparagus plants should be kept down in early spring, as they afford a good breeding place for the larvæ. Since the shoots are cut for the market every day or two, the eggs which may be deposited on them do not have time to hatch; and if the volunteer growth is kept down there will be little chance of any eggs hatching in the field.

Fresh air-slaked lime, dusted on the plants early in the morning, while the dew is on, has been reported by Dr. F. H. Chittenden as destructive to all grubs with which it comes in contact.

Arsenical poisons are of value upon plants that are not being cut for food, and possess the advantage of destroying beetles, as well as grubs. The application should be made at frequent intervals, or as often as the larvæ reappear. Arsenate of lead or Paris green in water are excellent sprays for this purpose. Dry arsenicals are also effective—as Paris green mixed



Fig. 2.—Common Asparagus Beetle, *Crioceris asparagi*: a, beetle; b, egg; c, newly hatched larva; d, full grown larva; e, pupa. Enlarged as indicated.

with lime, with lime and flour, or with land plaster.

CABBAGE AND CAULIFLOWER.

In Cook County gardens, cabbage and cauliflower rank in importance with such garden products as onions, cucumbers and potatoes. Not only are they among the most generally grown vegetables, but they are peculiarly susceptible to insect attack. In Illinois I have found the following insects doing noticeable damage to these crops: the imported or green cabbage worm, cutworms, the root maggot, plant lice, and fleabeetles.

THE IMPORTED CABBAGE WORM.

Pontia rapae Linn. (*Pieris rapae*.)

There is not a gardener who is unfamiliar with this common and destructive caterpillar. There are several "cabbage worms," but the commonest is the larva of the white butterfly (*Pontia rapae*) always to be found flying around cabbage fields during the summer. It emerges early in spring, having passed the winter in the chrysalis or pupa stage. The greenish eggs, small, slender and ribbed, are soon deposited, usually singly, on the leaves of early cabbages or other cruciferous plants. The velvety green larva (Fig. 3, a) begins to feed ravenously on the leaves immediately upon hatching. It gets its growth in ten to fourteen days and becomes a chrysalis (Fig. 3, b) changing to a white butterfly (Fig. 4 and 5) some eight to twelve days later. The length of the season and other general conditions have much influence in determining the number of generations in any year. There are certainly as many as three, on an average, in northern Illinois.

These caterpillars are not only injurious to cabbage, cauliflower, and other cruciferous plants, but they sometimes do much damage to lettuce.

Parasites.—There is hardly a field of cabbage or cauliflower infested with these green caterpillars in which we can not find masses of small white or yellowish cocoons. These cocoons are formed by small larvæ which live within the bodies of the cabbage worms, soon killing their hosts. Minute wasp-like adults emerge from the cocoons, and deposit eggs in the bodies of other cabbage worms. This parasite (*Apanteles glomeratus*) is a valuable friend to the cabbage and cauliflower grower, and it is sometimes abundant enough to free the field of cabbage worms, at least for the time being. Many gardeners make the serious mistake of destroying the cocoons of this parasite, believing them to be the eggs of the white butterfly.

Another parasite, *Pteromalus puparum*, kills many pupæ, or chrysalides, of this cabbage worm, and materially decreases the number of the next generation. Often the chrysalides from which the butterfly should have emerged, are dark brownish to black, and when broken open will be found to contain many maggot-like larvæ or dark brown pupæ. These have developed from eggs deposited in the living chrysalides by adults of *Pteromalus puparum*, which, like the parasite of the larva, is a small wasp-like insect. I have reared 48 to 58 of these parasites from single chrysalides.

In one large gardening district where cabbage and cauliflower are grown extensively, I could not find a single living worm or chrysalis August 26, 1908, although a few weeks before both had been abundant. All had been killed by their parasites.

Remedial Measures.—The following remedies are equally effective for any of the several caterpillars feeding on cabbage leaves, with the exception of cutworms, which will be treated later.

The use of arsenicals on cabbage and cauliflower is often discouraged because of the supposed danger to the consumer. Experiments with arsenate of lead and Paris green have been made, both in New York and in Kentucky, in which the sprayed plants were analyzed to determine the amount of poison remaining on them. It was found that only a slight trace, if any, was present—in no case enough to be dangerous, even if all consumed by one person. Cauliflower, however, should not be sprayed after the "flower" has begun to form, nor should cabbages be sprayed after they are two-thirds grown.

Paris green in one of the standard remedies, and is more used to-day in spraying for cabbage worms than any other insecticide. It may be applied dry or suspended in water, and specific directions for either use of it are given at the end of this article (page 36). A resin-lime mixture has been highly recommended by Mr. F. A. Sirrine,² who, after experiments with it, concluded that the yield of cabbages was increased 60 to 100 per cent by the treatment. He figures the cost of it at about \$2 an acre. Two applications are usually sufficient. Directions for the preparation of this mixture also may be found on page 36.

Arsenate of lead has been successfully used against the cabbage worm, but has the disadvantage of not adhering as well as the resin-lime mixture, although better than Paris green alone. It consequently must be applied oftener—sometimes as many as three



Fig. 3—Cabbage Butterfly, *Pontia rapae*: a, larva; b, pupa. Natural size.



Fig. 4—Cabbage Butterfly, *Pontia rapae*, male. Natural size.



Fig. 5—Cabbage Butterfly, *Pontia rapae*, female. Natural size.

² A Spraying Mixture for Cauliflower and Cabbage Worms. Bull. N. Y. Agr. Expr. Station, No. 144 (Sept. 1898) Geneva.

or four times a year, but ordinarily only twice. It has the advantage of being easy to prepare, and, as it is white one can easily see when the plants have been thoroughly sprayed.

Pyrethrum is also recommended for this insect. It is more expensive than the arsenicals, but has the two advantages over them that it is not injurious to man, and that it can be used later in the season than they—that is, when the heads are nearly formed.

Hot water at nearly boiling point will, of course, kill the worms, and is said to be harmless to the plants. Lime has been used against these worms, but it is ineffective, especially when they are numerous. Professor J. W. Lloyd says³ “cabbage worms were abundant late in the season, and in spite of five applications of air-slaked lime did considerable damage to the crop.”

Cabbage stalks and other debris should be removed from the field in fall and burned, unless, as recommended by Dr. F. H. Chittenden⁴ a few of the plants are left and poisoned as bait for the last generation of the insects.

THE VARIEGATED CUTWORM.

Peridroma margaritosa Haw. (*Agrotis saucia*, *Peridroma saucia*.)

Cutworms are sometimes very injurious to cabbage, cutting off the young plants and killing them outright. For this reason they are a worse pest than the green caterpillars; but they are not so widespread, and are therefore of less economic importance. The life history of the above species and a description of it are given in connection with insects affecting lettuce (page 25.)

Remedies.—Poisoned bait (see page 39) is probably the best remedy for cutworms. If they are known to be present, the bait should be put on the prepared field just before the cabbage plants are set out. If not, it should be used as soon as the presence of cutworms is recognized.

Spraying with an arsenical poison, such as Paris green, will destroy some of the insects if the spray is applied to the stems near the ground; but the stalks are probably more frequently cut off just below the surface of the ground than just above it, and in the former case the poison would not be eaten by the cutworms.

The collection of cutworms by hand is advised for some crops, but it would generally be too expensive for large cabbage fields.

THE CABBAGE ROOT MAGGOT.

Phorbia brassicae Bouche. (*Pegomyia brassicae*, *Anthomyia brassicae*.)

One of the most destructive enemies of cabbage and cauliflower in Illinois is the cabbage root maggot. It is white or cream colored, resembling the onion maggot. (Fig. 25), which is known to all Illinois gardeners. It is one of the immature stages of a fly which is much like the house fly in appearance, but more cylindrical, somewhat smaller, and of a grayish or brownish color. The winter may be passed in either the adult, puparium, or maggot stage, the flies hibernating in rubbish, buildings, or any accessible place that will afford shelter, the puparia in onion bulbs left in the fields in the soil, and the maggots in the refuse bulbs. Early in spring the flies deposit their small, elliptical white eggs in small cracks and crevices near the stem of the plant, or on the stem beneath the surface. Usually within a week—not so soon if the weather is cool, but often within 24 or 36 hours in the warmer parts of the year—small maggots hatch from the eggs, and immediately go into the ground and begin to feed on the roots or stalk. Becoming full-grown in a few weeks, they leave the roots to pupate in the soil near by. They remain in this dormant stage, as oval brown puparia, for about two weeks (in summer), and from these the adult flies emerge. There may be two or more generations in Illinois, according to the length of the season.

Most of the injury to cabbage and cauliflower by this maggot is done while the plants are small, and particularly to early cabbage. For this

³ The Farmer's Vegetable Garden. Bull. Ill. Agr. Expr. Station, No. 105, (Feb., 1906), p. 190.

⁴ Insects Injurious to Vegetables, p. 139. Orange Judd Co., New York, 1907.

reason the acreage of early cabbage has greatly decreased in this State within the last few years.

Economic Control.—Many methods have been recommended by various writers for the control of the cabbage root maggot, but most of these are preventive rather than remedial. Cabbage seldom brings a high price, and many measures that have been proposed are impracticable because of their cost.

For the *prevention of maggot attack in seed beds*, probably the most successful and practical method of protecting the young plants is that of screening them, as suggested by Dr. James Fletcher,⁵ and later successfully demonstrated on a large scale by Mr. W. J. Schoene.⁶ This consists in growing the seedlings under cheap frames, made of light wood and covered with cheesecloth (Fig. 6), to protect the plants from the cabbage maggot flies. In Mr. Schoene's experiments it proved very successful. He says: "Plants raised under cloth grew faster and reached the desired size for transplanting one week before the seedlings in the check [untreated] area. The screen

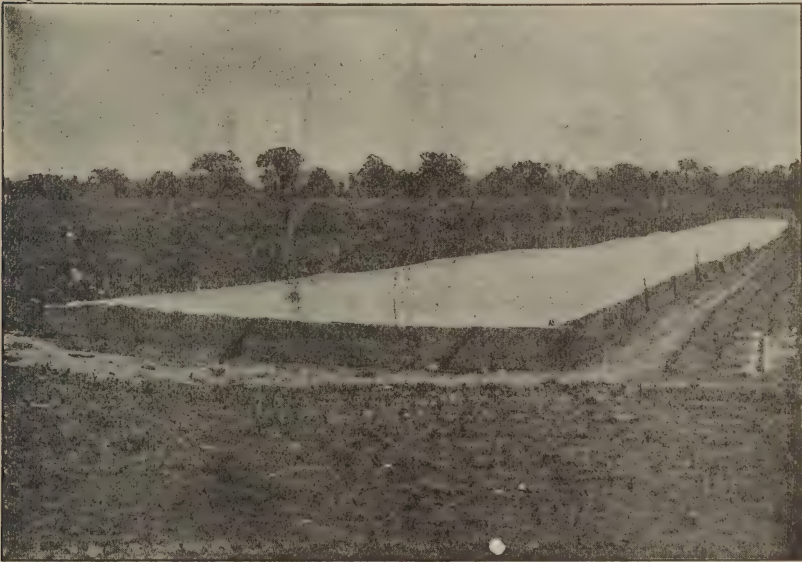


Fig. 6—Cabbage seed bed with frame and screening in position, to keep out the cabbage maggot, *Phorbia brassicae*.

sets were seasond by the removal of the covering thirteen days before the time of replanting, and showed no more wilting when transplanted than did the check seedlings."

"The screened bed was entirely free of maggots, and produced 50,000 sets, which were replanted. The check bed, of more than three times the size, yielded only 30,000 desirable plants. The cabbage maggots were generally very destructive to unprotected seedlings."

The total cost for material was approximately 40 cents for each 1,000 plants. The screens not only protect the plants from maggots, but also from the fleabeetles, which often do much damage to young cabbage.

For the *destruction of maggots at the time when seedlings are to be transplanted*, roots not too badly infested for use should either be washed off with water before resetting them, in order to remove the maggots, or, as

⁵Insects Injurious to Grain and Fodder Crops, Root Crops and Vegetables. Bull. Central Experimental Farms, Ottawa, Canada, No. 52 (June 1905), p. 35.

⁶Screenings for the Protection of Cabbage Seed Beds. Bull. N. Y. Agr. Exper. Station, No. 301 (March, 1908), Geneva.

Professor F. L. Washburn suggests,⁷ they may be dipped in a decoction of white hellebore—one part of the powder to two parts of water. The latter treatment is preferable, for while the water will have no effect on the maggots except to remove some of them, the hellebore may kill them all.

For the *prevention of maggot attack after transplanting*, probably the most successful measure is the use of tarred paper cards. Those ordinarily used are made of a thin grade of tarred felt paper, and are about $2\frac{1}{2}$ inches in diameter. They may be of any shape, but, as a matter of economy, are usually hexagonal, with a slit from one side to the center. The card is placed on the plant by separating the two edges of the slit and slipping the card around the plant so that the stem comes in the middle of the card. The card must then be pressed close to the stem and flat on the ground. This being done, the female fly must lay her eggs either on the card—where there is small chance of their hatching—on the stem—and if the card is close to the stem the young larvæ hatching from them will be unable to reach the roots—or else on the ground beyond the card, in which case the young larvæ, hatching so far from the plant, would probably be unable to reach it.

A carbolic acid and lime mixture (see page 39) has been recommended by others, but in our experience it proved worthless, the coat of lime cracking and leaving places for the deposit of eggs. After 24 hours the carbolic acid loses its value as a repellant. The mixture is applied along the rows with a sprinkling can or spraynozzle as the plants are transplanted, and in such manner as to coat the entire surface thinly around the plants.

Tobacco dust placed around the base of the plants has been found to prevent the female from depositing her eggs on or near them.

When these maggots have once gained a foothold in a cabbage field it is difficult, if not impossible, to exterminate them. The only practical insecticides which have been recommended are the carbolic acid emulsion, a decoction of hellebore, and carbon bisulfid (see pages 38 and 41), and these have given quite variable results. The carbon bisulfid has been used with success, but the expense of application prohibits its use in large commercial gardens. Hellebore decoction has given us very good results. A third of a pint should be poured at the base of each plant when transplanted, and each week thereafter for three or four weeks.

In using these insecticides it is necessary to make thorough application at the base of the plant before the maggots have had a chance to enter the root and protect themselves.

The application of commercial fertilizers is of much value. They stimulate the plant and make it more resistant to maggot attacks.

Clean farming and fall plowing aid in preventing maggot attack.

The use of "blood and bone," with hellebore, was suggested to us by a gardener, who reported that some of his cabbages had been protected from this maggot by this means, while plants not so treated were seriously damaged by it, as in previous years. We tried this material this year (1910), placing a small quantity of the dry mixture about each cabbage plant after transplanting to the field, but unfortunately for the test, the maggots were not present in injurious numbers either in the treated or untreated plots, and therefore no definite conclusions were reached. Upon examining the "blood and bone" around the plants, however, we found in it many maggots which were bred to adults and determined as *Phorbia fusciceps* Zett, a species closely related to the cabbage and onion maggots, and often injurious to the same crops. The same species infested "blood and bone" when applied to onions, the mixture being in this case drilled in on each side of the row. Although no recommendations can be made from these tests, it is thought best to make brief record of them.

THE CABBAGE PLANTLOUSE.

Aphis brassicae Linn.

During midsummer or early fall this plantlouse becomes noticeably abundant on cabbage and cauliflower plants, usually infesting the under sides

⁷ The Cabbage Maggot and other Injurious Insects of 1906. Bull. Minn. Agr. Exper. Station, No. 100 (Dec., 1906), p. 12. St. Anthony Park.

of the leaves in large, packed colonies, which rapidly increase in size unless checked by enemies or unfavorable weather. Both wingless and winged individuals are to be found, and though there are few of the latter as compared with the multitudes of the former, these few winged lice are the chief means of starting colonies in uninfested fields. Like other plant lice, the cabbage louse gives birth during the summer months to living young, without previous fertilization of the female by the male. In the fall, as observed by Fletcher, Garman, Quaintance, and others, both sexes are produced, and eggs are deposited on the stems and leaves of cabbages remaining in the field. Sometimes, however, viviparous females are found as late as midwinter, within the cabbage heads.

The lice are about the size of a pinhead, soft-bodied, pale greenish, but completely covered with a whitish powder or bloom which is not unlike the bloom on cabbage leaves.

Plantlice injure cabbage by sucking the juices of the plant. When abundant, they so disfigure and stunt it, especially the smaller and weaker plants, that it becomes unfit for market.

Natural Checks.—If it were not for the natural checks on its increase, the cabbage plantlouse would be one of the very worst pests with which the cabbage grower has to deal; but wet weather and its insect enemies greatly restrict its multiplication. It is not only subject to attack by many minute parasites, but it is preyed upon by several kinds of "ladybird" beetles and by the larva of a lacewing fly (*Chrysopa*), whose combined attacks greatly lessen the numbers of the aphids, and hold them in check.

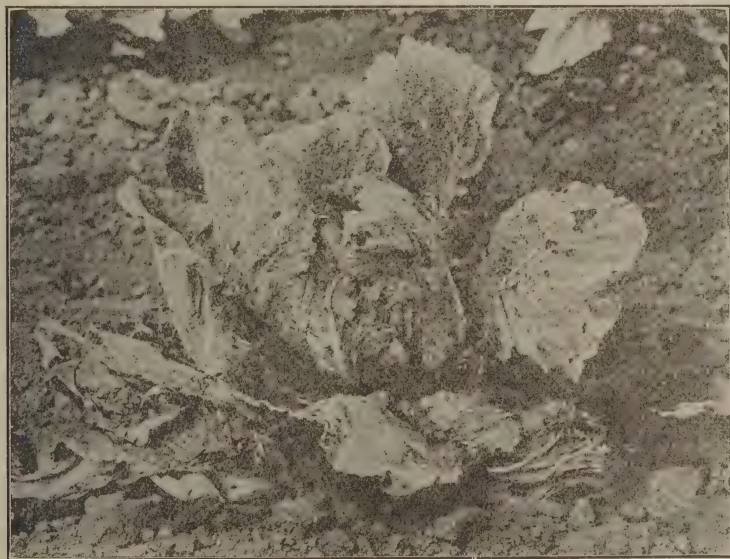


Fig. 7.—Cabbage Plantlouse, *Aphis brassicae*, on head of cabbage.

Remedies.—Probably the most successful method of dealing with the cabbage louse is fumigation with carbon bisulfid. This substance was tested by us in the fall of 1908 on cabbages badly infested with plantlice. Fumigation of cabbage or cauliflower on a commercial scale with individual covers for the plants would be too expensive for profit; but an economical method is to cover a considerable area of plants with large canvass or muslin sheets, with props at the corners and center, and wherever else may be necessary.⁸ The cover being ready, dishes are placed beneath it con-

⁸ The Melon Louse and other Aphids, by C. E. Sanborn. Bull. Texas Agr. Exper. Station, No. 89, (not dated) page 47, College station,

taining the carbon bisulfid at the rate of a teaspoonful to each cubic foot of space. The edges of the cloth, which should lie on the ground, are covered with earth to prevent, as far as possible, the escape of the fumes. After forty-five minutes to an hour the cover may be removed. This treatment also killed the thrips and cabbage worms which infested the plants, but it did not kill the parasites concealed in the aphid skins—which fact is greatly in its favor. With exposures of 20 and 30 minutes, nearly all the lice were killed; but with only 15 minutes or less, practically none were killed. (For other particulars concerning the use of carbon bisulfid see page 41.) Mr. C. E. Sanborn⁹ has recommended the use of "Aphis Punk" or "Nico-Fume" paper in fumigating plants under cover.

Kerosene emulsion of a 10 per cent strength is the standard spray for the cabbage plantlouse. Care should be taken to spray thoroughly the under side of the leaves, where the lice are usually most abundant, for the liquid must come in contact with the insects in order to kill them. (For formula, etc., see page 38).

Tobacco decoction and various soap mixtures have been recommended for this plantlouse, but they are less effective than the kerosene emulsion. It is hardly necessary to say that treatment should begin at the first appearance of the lice.

Clean culture, especially the destruction of the cabbage and cauliflower stalks in fall, is very important, to destroy the eggs which are deposited on the cabbage and related plants, and likewise to destroy the young and adult lice which may be hibernating on the same kinds of plants.

THE CABBAGE FLEABETTER.

Phyllotreta vittata Fabr.

This fleabeetle, often very abundant and destructive, is the only one of the many fleabeetles—so named because of their remarkable leaping ability—which has been found injuring cabbage in northern Illinois. It is a black, shining, oval beetle (Fig. 8, *a*) about .08 inch long, with a broad, wavy longitudinal marking of pale yellow on each wing cover. It sometimes injures other crops, especially radishes, and its food plants include many weeds. It injures plants by eating innumerable holes and pits in the leaves. It is most destructive to cabbages early in the year, when the plants are less than two inches high, at which stage they easily succumb to such attacks.

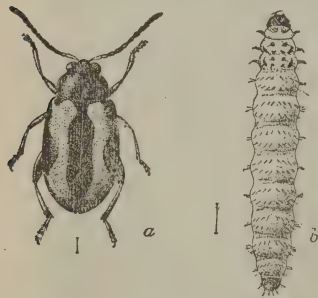


Fig. 8.—Cabbage Fleabeetle, *Phyllotreta vittata*: *a*, beetle; *b*, larva. Enlarged as indicated.

I quote in full the concise paragraph on the life history of the immature stages of this flea beetle given by Professor H. Garman.¹⁰

"The early history of the cabbage flea-beetle was made out in 1865 by Dr. Shimer, of Mt. Carroll, Illinois. He found that the larva (Fig. 8, *b*) feeds on the roots of cabbage, in which respect it is different from a very similar European beetle, and also from the next one [*P. sinuata*] treated in this paper, both of them being leaf-miners. The eggs of this beetle are placed at the base of the plant. The grubs hatching from them work their way into the earth, mining and feeding on the roots, in some cases completely destroying the plants. When fully grown they are about one-fifth inch long, yellowish white in general color, the head dark brown. They desert the roots when ready to change to pupæ, and pushing into the earth a short distance, make a small cell, in which the change takes place."

Prevention and Remedies—A useful method of preventing fleabeetle attack recommended by Mr. W. J. Schoene,¹¹ consists in screening the seed

⁹ Loc. cit.

¹⁰ Insects Injurious to Cabbage. Bull. Ky. Agr. Exper. Station, No. 114 (June, 1904), p. 37. Lexington.

¹¹ Bull. New York Agr. Exper. Station, No. 301 (March, 1908), p. 170. Geneva.

beds, as described on page 9 for the protection of seedlings against the attacks of the cabbage root maggot. The most effective treatment is spraying with Paris green or arsenate of lead, using Bordeaux mixture as a diluent (see pages 37 and 38). To use Bordeaux is not absolutely necessary, but as it is a powerful repellent it adds to the value of the spray.

Many other remedial measures have been recommended, such as powdering the plants with air-slaked lime, soot, road dust, wood ashes, tobacco dust, etc., these substances acting as repellents, or with Paris green and lime—though the latter mixture is more effective as a liquid spray; and spraying kerosene emulsion around the base of the plants is said to destroy the eggs and young larvæ of this insect.

Cultural Methods.—As the flea beetle feeds on many weeds, especially the crucifers, all weeds in the immediate vicinity of the garden should be destroyed.

CUCUMBER AND MELON.

Cucumbers and melons are among the most important garden products in Illinois. In 1899, 2,580 acres were devoted to cucumbers, and 466,876 bushels were marketed. This report does not include cucumbers grown throughout the State under many hundred thousands of square feet of glass. The same year there were 10,963 acres in water-melons and muskmelons in Illinois. The acreage in both these crops has greatly increased since 1899.

The most important insect enemies of these plants are, outdoors, the striped cucumber beetle, the squashbug, and the melon aphid; and, in greenhouses, thrips and the whitefly. Although they are not insects, two other greenhouse pests should be mentioned, namely the red spider, and a nematode worm commonly known as the eelworm.

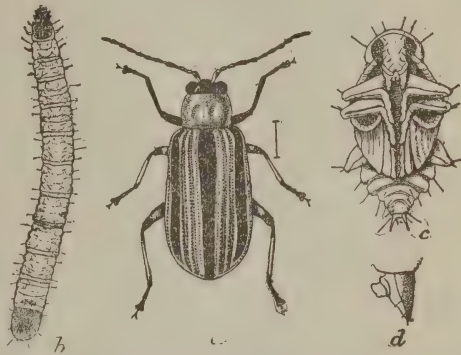


Fig. 9.—Striped Cucumber Beetle, *Diabrotica vittata*: a, beetle; b, larva; c, pupa; d, tip of larva, side view. Enlarged as indicated.

THE STRIPED CUCUMBER BEETLE.

Diabrotica vittata Fabr.

Ordinarily this is a pest which the gardener must carefully guard against. As the young cucumber, melon, or other cucurbitaceous plants make their appearance above ground, they are attacked by these ravenous beetles, and large areas may be killed by them in a few days.

The beetle (Fig. 9, a) is small (about two-fifths of an inch long), with black head, yellowish thorax, and yellowish wing covers, marked lengthwise with three black stripes. It passes the winter in the ground or beneath boards or similar shelter, and as the young food plants appear above ground—usually about the first week in June—it comes forth and feeds on their leaves. If the beetles are at all abundant they may soon devour the small tender plants. They feed continuously and voraciously for a week or ten days, and then commence to pair. The eggs (Fig 10) are deposited singly, and may usually be found on the under surface of the leaf, on the stem near its base, or on the ground near the plant. The larvæ (Fig. 9, b, d) upon hatching, feed within the stalks or on the roots, or sometimes on the fruit and vines as they lie upon the ground. The length of the larval period no doubt varies greatly, depending on the food supply and climatic conditions. The pupa (Fig. 9, c) is formed in an earthen cell in the soil, and the transformation to the adult beetle is completed within 7 to 14 days. Although the beetles of this new generation begin to emerge the latter part of July, they may continue to appear throughout August. Professor

Garman, in his studies of this insect,¹² found that in confinement the entire life cycle of an individual was 26 to 33 days. It is possible that a second generation may appear in the southern part of the State, but in northern Illinois probably but one full generation occurs under normal conditions.



Fig. 10—Striped Cucumber Beetle, *Diabrotica vittata*, egg, much enlarged, with portion of surface more highly magnified at right.

Preventive and Remedial Measures.—A large number and variety of methods for the control of this insect have been recommended, but only those which have given promising results will be discussed. One of the oldest methods for protecting the young plants from the cucumber beetle is covering them with a screen; but while this is very satisfactory in small gardens, it is not so practicable on a large scale as the use of the Bordeaux mixture in connection with a trap crop, as discussed farther on. It has been found that for a short time in spring, before the beetles begin to pair, they may be killed with a spray of Paris green or arsenate of lead, but that they will not feed readily upon sprayed foliage after pairing, and arsenicals alone can not be generally recommended for the cucumber beetle without further tests of their efficiency.

The use of squash as a trap crop (Fig. 11) in combination with a spray of Bordeaux mixture or Bordeaux and arsenate of lead on the cucumber plants and an arsenical poison on the squash, is one of the best means of preventing the attacks of these beetles. Mr. F. A. Sirrine has given a very complete account of this method of treatment based on his own experiments, and the following is taken largely from his paper:¹³

Squash seed is planted around the margin of the field about four days previous to planting it with cucumbers, or other crop.¹⁴ At the time of cucumber planting there should be a second planting of squash seed on the margins of the field. At the first appearance of the beetles about half the squash vines should be dusted with some easily obtainable arsenite, and soon after the cucumber plants appear above ground they should be sprayed with Bordeaux mixture, using the 4-4-50 formula (for preparation see page 37). At about the same time the cucumber plants are sprayed with Bordeaux the squash vines should again be dusted with an arsenite. Two weeks after the cucumber plants have appeared all the squash plants may be removed, except a few which should be left until the cucumber vines have set fruit, as the beetles will feed on the squash flowers in preference to those of the cucumber. Sirrine recommends spraying the cucumbers with Bordeaux mixture three times; first, as soon as the seed leaves are exposed; second, when the third true leaf appears; and last, just before the plants commence to vine. He says: "The cost of three applications of the Bordeaux mixture will not exceed \$2.00 per acre; whereas, the cost of wire covers would be \$40.00 per acre, and they probably will not last over three years."

Repellents are effective against this beetle, and Bordeaux mixture is one of the best, although it is best to use it in connection with a trap crop, as above described. Other much used repellents are air-slaked lime, land-plaster, sifted ashes, road dust and tobacco dust, but these are not always effective when the beetles are abundant.

Clean culture will prevent much of the damage commonly done by many of the common garden pests, and it is especially effective against the cucumber beetle. It has been recommended in this connection, that as soon as the crop is harvested the vines be covered with straw and burned. This is a far better practice than that of gathering them up before destroying

¹² Enemies of Cucumbers and Related Plants. Bull. Agr. Exper. Station, No. 91 (March 8, 1901), p. 5. Lexington.

¹³ Combating the Striped Beetle on Cucumbers. Bull. N. Y. Agr. Exper. Station, No. 158 (May, 1899), pp. 14-16. Geneva.

¹⁴ Mr. Sirrine informs us that only the Hubbard or the Boston Marrow squash should be used, these being by far the most attractive to the beetles.

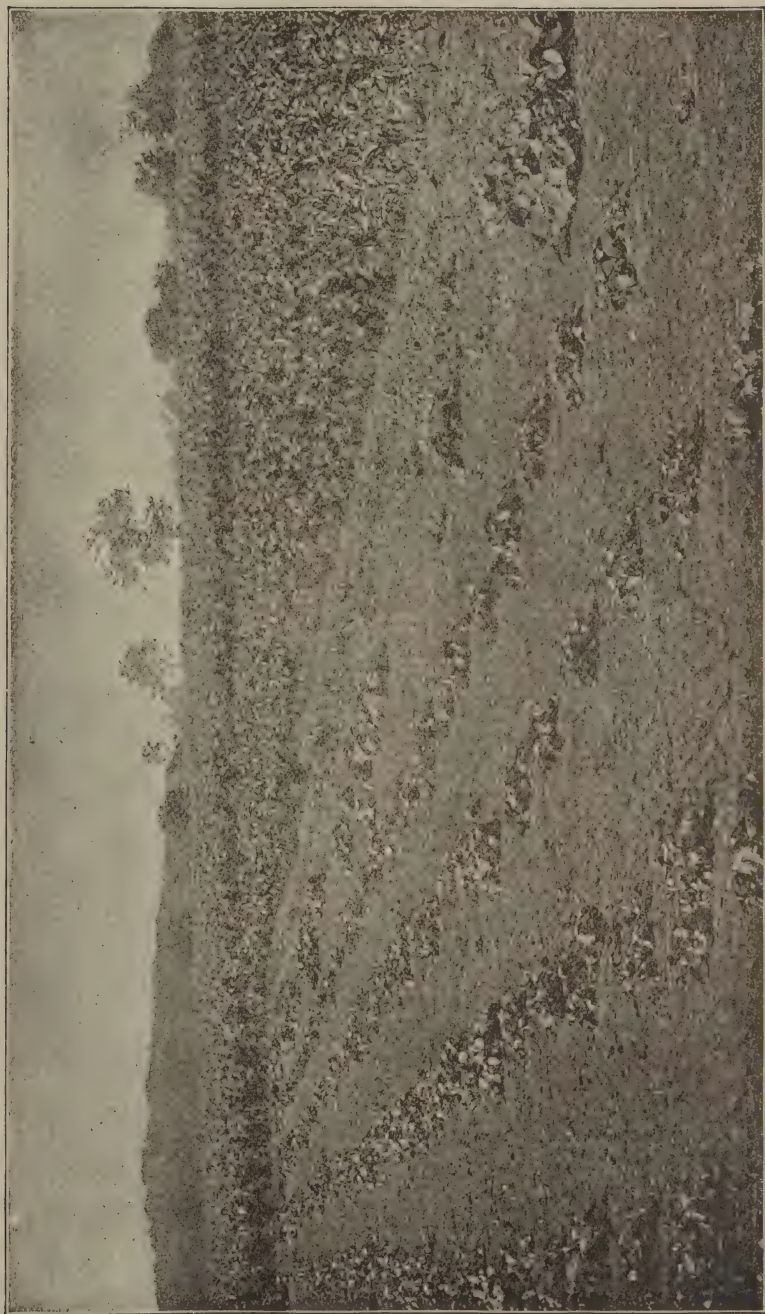


Fig. 11.—Cucumber field with squashes along its border to attract the Striped Cucumber Beetle.

them, as the latter procedure leaves many of the beetles undisturbed in the field.

THE SQUASHBUG.

Anasa tristis DeGeer.

The squashbug, although confining its attacks largely to the squash and other plants of the gourd family, is often very injurious to the cucumber in early spring, when emerging from its winter quarters. It finds its way into the cold frames in which the plants are being started, when no other food plant is available.

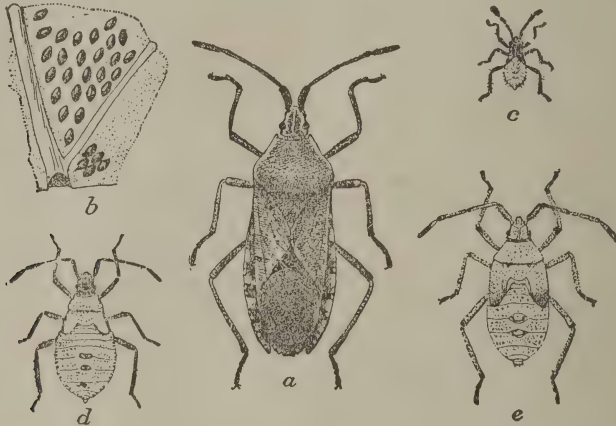


Fig. 12—Squashbug, *Anasa tristis*: a, adult; b, egg cluster; c, d, e, young in different stages. Twice natural size.

This large, ill-smelling, dark brown bug (Fig. 12 a) hibernates as an adult in rubbish, sheds, and woodpiles, under loose bark on stumps, or in any other available place of protection. In northern Illinois the bugs make their appearance about the middle or the last of June, or even later; but I have found most of their injury to the cucumber done while the young seedlings are in the cold frames. In all such cases these frames were near woodpiles or outbuildings, and during the occasional warm days of spring, when the frames were opened, the bugs gained entrance, the temperature of these beds making them fully active. Shortly after coming from their winter quarters they deposit the conspicuous clusters of glossy yellowish-brown eggs (Fig. 12, b), usually on the under side of the leaves. The young, light grey bugs (Fig. 12, c) hatching from these, immediately begin sucking the juices of the plants. In their later immature stages (Fig. 12, d, e)—which differ only in size from the young bug as it hatches from the egg—they feed, as do the adults, upon the juices of the plant. The loss of sap, however, is not the primary cause of the wilting of the plants. This is due principally, if not wholly, to a liquid poison which the bug introduces into the wound which it makes. In some cases it also gives entrance to a bacillus which causes a wilt disease.

Methods of control.—Collecting the bugs under board traps is probably the most satisfactory of the various methods suggested for the control of this pest. This should be done in early spring, as soon as the bugs appear. The boards are simply laid on the ground as a decoy shelter for them during the night and here they may be easily captured early in the morning. The eggs should likewise be collected and destroyed as fast as they are laid on the leaves.

Kerosene emulsion kills the young bugs without injuring the plants if it is very carefully applied, but it is too dangerous for ordinary use.

Here again clean-farming methods are of much importance. Cold frames should be placed at some distance from woodpiles and outbuildings, and as soon as the crop has been gathered the vines should be covered with straw or other easily inflammable material and burned.

THE MELON APHIS.

Aphis gossypii Glover. (*Aphis cucumeris*).Fig. 13—Melon Aphis, *Aphis gossypii*, its work.Fig. 14—Melon Aphis, *Aphis gossypii*: a, winged female; aa, enlarged antenna of same; ab, dark female, side view; b, young nymph or larva; c, last stage of nymph; d, wingless female—all greatly enlarged.

Although the truck gardener may not have noticed the melon aphid on his cucumber leaves, a curling of the leaves (Fig. 13) is presumptive evidence of its presence in injurious numbers. It is not only a serious outdoor pest, but is often very injurious to cucumbers in greenhouses.

This plantlouse (Fig. 14) varies in color from pale yellowish to blackish green. Its life history and insect enemies are very similar to those of many other plantlice, such as the one which has already been discussed as a cabbage insect (page 10). Briefly, the melon aphid appears on cucumber and melon plants early in the season, and increases rapidly in numbers during the summer unless checked by its insect enemies or by unfavorable weather. It is still doubtful whether it ever produces eggs to carry the species over winter, but it is known that viviparous females—the form found throughout the summer—may hibernate in some parts of Illinois.

Remedial measures.—The measures recommend for the control of the cabbage louse (pages 11 and 12) may be used against the melon aphid, and of these fumigation with carbon bisulfid is doubtless the most efficient (see page 41).

Owing to the large number of its food plants, clean culture is especially important in dealing with the melon aphid, particularly the cutting and burning of weeds and old vines; and fall plowing is also advisable.

In greenhouses, fumigation with hydrocyanic gas is doubtless the best treatment for this insect. The procedure is described on pages 40 and 41.

THE GREENHOUSE WHITEFLY.

Aleyrodes vaporariorum Westwood.

One of the most troublesome and destructive insects with which the greenhouse vegetable gardener must deal is the whitefly. This little pest

attacks cucumbers, tomatoes, peppers, and lettuce under glass, and a considerable variety of flowering and ornamental plants.

The winged adult (Fig. 16) is about .06 (one seven-teenth) of an inch in length, and looks as if dusted with flour. The minute irregularly ovoid eggs are deposited on the under surface of the leaves, to which each is attached by a very short, slender stalk. Recently hatched larvæ are flat, oval in outline, and transparent or translucent according to age. They settle on the leaf close to the empty eggshells, soon attach themselves, and there remain (Fig. 15), molt-

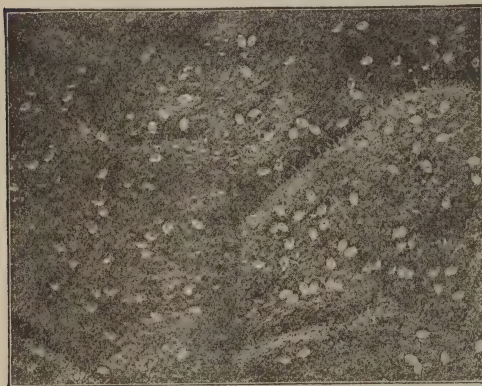


Fig. 15—White Fly, *Aleyrodes vaporariorum*, nymphs on leaf. Twice natural size.

ing four times and becoming adult with the last molt. The entire life cycle of the whitefly from the time the egg is deposited until the adult emerges, is completed in a month to five and a half weeks, at the ordinary greenhouse temperature in summer.

The larvæ and pupæ secrete a honeydew which falls on the leaves below them; and on badly infested plants, where this liquid becomes abundant, a sooty fungous growth appears on the leaves covered with it, which hastens the death of the plants.

Parasites.—In the University greenhouse, at Urbana, many of the plants, especially *Salvia* and pansy-geranium, were badly infested the midwinter

of 1908 by the little whitefly, but two months later these insects were found to have been almost exterminated by a minute hymenopterous parasite, which proved to be a new species, and has since been described by Mr. A. A. Girault as *Encarsia versicolor*.¹⁵ It attacks the immature forms of the whitefly, and the infested young may be recognized by their black color, those not infested being pale greenish.

Remedies. — Fumigation with hydrocyanic acid gas is by far the most efficient means known for controlling the whitefly in greenhouses. In ordinary greenhouses it may be used at a strength of



Fig. 16—White Fly, *Aleyrodes vaporariorum*, adults on leaf. Twice natural size.

¹⁵ *Encarsia versicolor* species novum, a Eulophid Parasite of the Greenhouse Whitefly, *Aleyrodes vaporariorum* Westwood. *Psyche*, Vol. XV, No. 3 (June, 1908), pp. 53-57. Cambridge, Mass.

one ounce of cyanide of potassium to 3,000 cubic feet of space. In new tightly built houses a smaller quantity may be used; but in very loosely built or weather-shrunken houses more must be used. The mode of using this gas is described on pages 40 and 41. It is commonly necessary to fumigate three or four times, at intervals of about two weeks.

Fumigation with tobacco stems, or with any of the commercial tobacco extracts, is partially effective against this insect, and where the use of hydrocyanic acid gas is impracticable this treatment is recommended (pages 39 and 42). More fumigations will be required, but if persistently followed up, the whitefly can be kept in check by this means.

THE ONION THIRPS.

Thrips tabaci Lind.

This insect, which is very injurious to cucumber plants in the greenhouse, is discussed in connection with its injury to the onion (page 28). In the greenhouse its life history is the same as out of doors, excepting that the life cycle varies greatly in length under the various artificial conditions which prevail in greenhouses. As a rule, cucumbers are started under glass in fall, and it is at this time that the thrips migrates from out-door vegetation into the houses. It breeds successfully on almost any kind of greenhouse vegetation, and may soon become well established; but it is not usually until midwinter that it becomes abundant enough to alarm the gardener.

Remedial Measures.—Clean culture is one of the most important means of holding this pest in check. As a rule the grasses and weeds around greenhouses are badly infested with thrips in summer, when the greenhouses are not in use, and on these plants it continues to breed until fall, when the seed heads of such plants as pigweed (*Amarantus retroflexus*), wild sunflower (*Helianthus retroflexus*), and foxtail grass (*Chaetochloa viridis*) are filled with winged thrips ready to migrate into the houses. It is very important, consequently, that all weeds should at least be kept down by cutting, though it is much better to cultivate the land several times during the summer to prevent weeds and grasses from coming up. Cold frames to be used in starting young plants should not be placed near an infested onion field, nor where vegetation is allowed to grow wild.

Spraying and fumigation with tobacco extracts (pages 39 and 42) throughout the fall and winter will hold the thrips in check. The gardener should not wait until his plants are visibly injured, but should continually look for the insect, and as soon as the first thrips is found, should begin operations.

Hydrocyanic acid gas has been used by some with apparent success. In a small greenhouse containing 4,500 cubic feet of space, we were successful in killing 99 per cent of the thrips, without injury to the cucumber plants, by using the gas at a strength of one ounce of cyanide of potassium to 2,000 cubic feet. The maximum and minimum temperatures throughout the period of fumigation, which lasted all night, were 74° and 65° F. respectively.

Kerosene and soap emulsions (page 38) are effective against the thrips before the plants have made much foliage, but at a later period it is impossible to spray thoroughly under the surface of all the leaves and as these emulsions kill by contact it is of the greatest importance to reach all the insects.

Dipping the leaves of small plants in a soap solution just before transplanting them to the greenhouses has been found useful when plants become infested in cold frames.

THE RED SPIDER.

Tetranychus bimaculatus Harvey. (*Tetranychus telarius*).

This common pest is a tiny mite rather than a true spider. It has been a source of trouble to the indoor cucumber grower for years, and although it can usually be kept in check by careful and thorough cultural and spraying methods, it is a veritable pest when it once obtains a foothold. It is a

general feeder, and among the out-door vegetables which it often injures are celery and eggplant.

This mite (Fig. 17 and 18) is so familiar to growers that a brief description will suffice. It is about one-fiftieth of an inch long, oval, with four pairs of legs, and usually a dark spot on each side. This latter character, however, is not constant. The general color also varies, some mites having a decidedly reddish tint, while others are almost colorless. They spin fine webs over the surface of the leaf—usually on the under side—beneath which they live, and it is largely for this reason that they are hard to reach. The minute eggs are globular, pale and transparent when deposited, but later change to reddish. They are commonly placed on the under surface of the leaf, but sometimes on other parts of the plant. The young mites mature in about ten or twelve days.



Fig. 17—Red Spider, *Tetranychus bimaculatus*, male, greatly magnified.

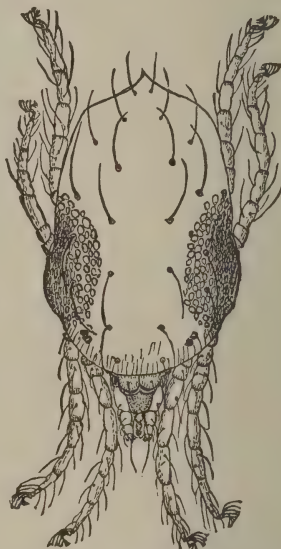


Fig. 18—Red Spider, *Tetranychus bimaculatus*, female, greatly magnified.

Remedial Measures.—This pest can usually be held in check, or even exterminated, by thorough and timely spraying of the plants with water, if the spray is fine and the pressure considerable; but this is a preventive rather than a remedial measure, for, owing to the excessive rate of multiplication of the mites in a hot, dry atmosphere, and owing further to the fact that the web beneath which they live becomes denser as their numbers increase, the spraying is ineffective unless it is done while the infestation is still slight. Indeed, no treatment is of much practical value if the mites have become well established on living plants. A special nozzle introduced by Dr. B. T. Galloway, of the U. S. Department of Agriculture for use against the red spider is very effective, "As it readily serves to keep the leaves in a thoroughly healthy condition, and at the same time wets the beds but little."¹⁶

Fumes of sulphur or hydrocyanic acid gas will kill the red spider, but the strength required is by far greater than the plants will stand. After the cucumber or other crop has been gathered, and before infested vines have been removed, it is advisable to fumigate them with one of these two substances, using one ounce of cyanide of potassium to one hundred cubic feet of space, or burning one pound of sulphur to one thousand cubic feet.

¹⁶ The Common Red Spider, by F. H. Chittenden. Circ. U. S. Dept. of Agr., Bur. of Ent., No. 104 (Jan. 26, 1909), p. 8.

It is hardly necessary to say that these strengths will kill living plants. (For full directions for the use of these materials, see pages 40 and 42.)

Sulphur is one of the best remedies for the red spider, and most of the remedies that have been recommended require sulphur as one of the ingredients. Liberally dusting the plants with sulphur after syringing is effective, or better, applying a spray consisting of one ounce of sulphur to one gallon of water. A little soap added to this sulphur solution will increase its efficiency.

Soap solutions, either whale oil or a neutral soap such as the "Ivory," are of great value in the eradication of the pest, but the addition of sulphur as mentioned above increases their value.

A lye-sulphur mixture has recently been recommended by Dr. F. H. Chittenden, and is said to be more effective than any of the many other materials tested. Directions for preparing this spray are given on page 39.

Whatever insecticide is used, especially when the infestation is severe, should be applied with as great pressure as practicable, for the greatest trouble in controlling this mite arises from the difficulty in penetrating the web which it spins. The stream should also be directed to the lower surfaces of the leaves, for it is here that the spider is most often found.

THE EELWORM.

Heterodera radiculicola Greeff.

The eelworm is a common pest in hothouses, particularly injurious to the cucumber, and, unfortunately, it is apparently becoming more widespread each year. In Illinois it is known only as a greenhouse pest, and our observations indicate that here, at least, it is unable to survive the winter in the field.

The only unmistakable indications of the presence of this root-feeding worm are the swellings or enlargements of the roots (Fig. 20) often referred to by the gardener as root-knots.¹⁷ These root-knots vary in size and shape, largely according to the number of worms present, to their position on the roots, and to the kind of plant. The presence of eelworms may be indicated by a sickly appearance of the plant, by the dying of its leaves, and by its final collapse, although nothing but an examination of its roots can certainly incriminate the species. Plants are commonly half grown or bearing fruit before they are noticeably weakened by the eelworm.

The young eelworm (Fig. 19) is very minute and elongate. It is provided with a spearlike organ projecting from the head, and with this it pierces the tender root (Fig. 21), in which it ultimately imbeds itself. The worms continue to grow—in width rather than in length—within the root, the female finally becoming club-shaped, but the male resuming its original slender form. The young, hatching from the eggs laid within the root, make their way into the soil, and thence into new roots.

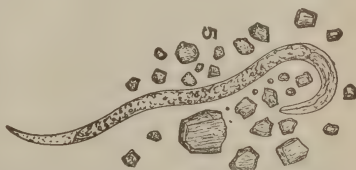


Fig. 19—Nematode Worm, *Heterodera radiculicola*, among particles of soil. Greatly magnified.

Preventive and Remedial Measures.—

Tools which have been used in soil infested by eelworms should be thoroughly washed or, better, sterilized before using them in other soil.

Among the most suggestive methods of treating infested greenhouses is that used by Mr. W. F. Preston, of Dixon, Illinois. Having had serious trouble with nematodes on cucumber plants, he used the sterilization process about to be described, but, owing to the "solid bed," worms in the unsterilized soil below soon reinfested the treated soil. To prevent this, a cement floor was put in the bed about ten inches below the top, the wooden sides being retained. The nematodes did not reappear until the following summer, when the vines were old and ready to be removed, as was also the soil. They then gained entrance between the cement floor of the bed and

¹⁷ This deformity should not be confused with the clubroot of cabbage and related plants, which is due to bacterial disease.



Fig. 20—Cucumber roots showing galls of a nematode, *Heterodera radiculicola*.

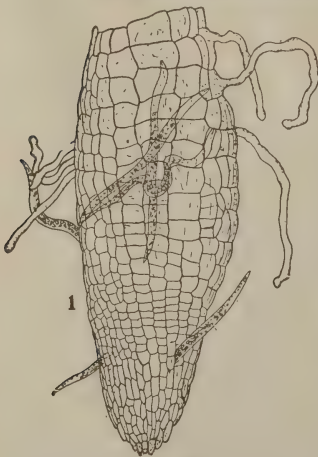


Fig. 21—Tip of cucumber root with young nematodes, *Heterodera radiculicola*, just entering. Enlarged.

the wooden side walls. The soil could probably be wholly protected by making the sides as well as the floor of cement, sloping the floor from the center towards each side, and leaving holes along the sides, near the floor of the bed, for drainage.

Sterilization of the soil by steam is the most efficient measure of controlling the eelworm, as well as many insect pests ordinarily introduced into the greenhouse with the soil, and various ways of accomplishing this have been devised by hothouse gardeners. Perhaps the earliest record of this soil treatment is that of Mr. W. N. Rudd,¹⁸ of Chicago, who used it successfully in 1893. The most practical and economical method with which I am acquainted, is that of Mr. J. F. Ammann, of Edwardsville, Illinois. Into a sterilizing bin of rough boards, measuring two feet high, 10 feet wide, and 20 feet long, about a foot of soil is placed, and a heating apparatus of five "runs" of old perforated two-inch pipe is laid and connected with the steam supply.

¹⁸ Killing Grubs in Soil. American Florist (Chicago), Vol. IX, Sept. 28, 1893, p. 171.

Another foot of soil is added, and potatoes are placed in the bin, one at each end and another in the center. The bin is then covered with a tarpaulin, and 80 pounds of steam are turned into the pipes for about an hour and a half, or until the potatoes are well cooked.

LETTUCE.

The cultivation of lettuce, though carried on throughout the year, is confined to hothouses during the cooler months. The hothouse product is far the most important, and it is to this that insect pests are the most troublesome. Cutworms, the lettuce plantlouse, and the cabbage worm are usually abundant enough to do it much damage, and need the close attention of the lettuce grower.

THE VARIEGATED CUTWORM.

Peridroma margaritosa Haw. (*Peridroma saucia*, *Agrotis saucia*).

Young lettuce, cabbage and other plants, are often cut off, or otherwise eaten, by some unseen insect, and later the leaves may be so badly eaten as to ruin them for market. In such cases, if one searches near the plant, just beneath the surface of the soil, he is almost certain to find a grayish or dark fleshy cutworm.

The only cutworm I found feeding on lettuce and other vegetables in the greenhouses and out-of-doors in 1908 was the species named above. The egg (Fig. 22, *e*) from which it hatches is about one-fiftieth of an inch in diameter, dome-shaped, with vertical ribs. When first laid it is creamy white with a pearly luster, but it soon changes to a pinkish tint, and finally to lilac or darker. The parent moth may deposit 500 eggs, or even more,

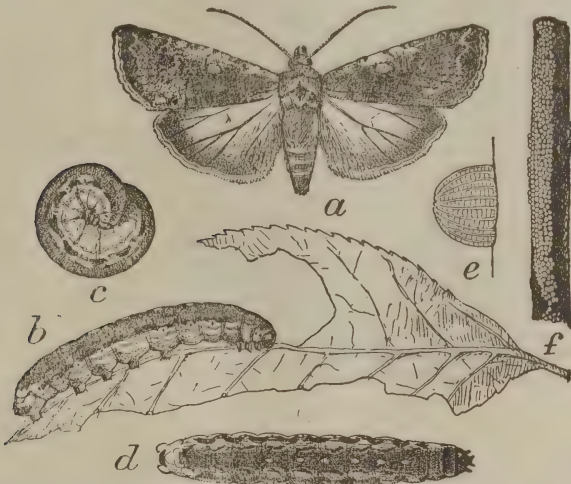


Fig. 22—Variegated Cutworm, *Peridroma margaritosa*: *a*, adult; *b*, larva, side view; *c*, same, curled up; *d*, dark-colored larva, seen from above; *e*, single egg; *f*, cluster of eggs on twig. All natural size except egg.

in masses of 60 and upwards (Fig. 22, *f*). The larva hatches in five or six days, and after eating the egg shell from which it has emerged, begins feeding on the lettuce leaf. When full grown (Fig. 22, *b*, *c*, *d*) it is about an inch and a half long. It is usually dull, blackish brown, mottled with gray, some larvæ being paler and others darker. A characteristic marking is a row of four to six yellowish dots along the median line of the back. This cutworm feeds at night, and hides during the day in the soil just beneath the surface, or under boards or rubbish near the plant. It remains a cutworm for 25 to 30 days, and then goes into the ground and pupates in an oval earthen cell, usually found just below the surface. Fifteen to nineteen days later it comes out as a moth (Fig. 22, *a*). The pupa is shin-

ing reddish brown, growing darker with age. It is about an inch long, slightly pointed at one end and rounded at the other. The moth measures about one and three quarter inches across the expanded wings. The fore wings are brownish, mottled with black or gray, the shades and markings varying considerably. The hind wings are nearly uniform grayish or pale brownish, with a darker border. Like the larva, the moth is nocturnal in habit, and the eggs are laid at night. The adult may live a week or more, but rarely lasts more than ten days. The complete life cycle in summer requires 45 to 54 days, but in winter, in greenhouses, the period is much longer. Out-of-doors there are two generations in a year, and in greenhouses probably four or more. According to various writers the winter may be passed outdoors in either the pupal, larval, or adult stage.

Natural Enemies.—A single tachinid fly (*Archytes aterrima* Desv.)¹⁹ has been bred from this cutworm in Illinois, but three species of these flies and several hymenopterous parasites have been reported to infest it elsewhere. None of these, however, is of much importance in lessening its numbers.

Remedial Measures.—In the greenhouse, for such vegetables as lettuce, insecticides may best be used in the form of a poisoned bait. Successful experiments against cutworms were made by me in a Chicago greenhouse this year (1908) with both poisoned bran and poisoned lettuce leaves. In



Fig. 23—Trap lantern for adults of cutworm.

A lantern trap (Fig. 23) is also useful in the greenhouse. This consists of a tub with an inch or two of water in the bottom and a little kerosene to form a surface film, and a lantern is hung over the tub to be kept burning for several nights. The moths are attracted by the light, and in flying around it drop into the tub and are killed by the oil.

Out-of-doors plants, such as cabbages, beets and onions, may be protected by the use of poisoned bran mash, the formula for which is given on page 39. This should be placed in small piles, about a tablespoonful to a pile, at the bases of the plants. When a field which has been in grass is to be planted to vegetables, it is well to use the poisoned bran in spring, shortly before planting the crop.

Dusting or spraying plants with Paris green or arsenate of lead is effective against cutworms and safe for most vegetables, but not for lettuce.

It is often easier to pick, brush, or shake off cutworms than to destroy them by poison.

¹⁹ Determined by C. A. Hart.

lettuce houses the latter will usually be the most convenient. If the soil is new, and especially if it is a sod soil, lettuce leaves should be laid on the beds and dry Paris green sprinkled lightly over them before the crop is planted. Or if the lettuce has already been planted, it should be pulled up if cutworms are abundant, and a row of lettuce leaves should be laid along each side or in the center of the bed, and then poisoned. Even though there are but very few cutworms in the greenhouse, it is always best to repeat this process at the final gathering of each crop. It is but little trouble to lay fresh refuse leaves along the bed and sprinkle them with the poison.

In agricultural practice, early fall plowing is often helpful if done while cutworms are still actively feeding. Their food being thus destroyed, many will starve, and others will be too weak to survive the winter. On the other hand, if the plowing is delayed until the cutworms have pupated, little or no benefit will follow. Crop rotation may sometimes be useful, but as very few garden plants are unmolested by cutworms, it is not to be relied on. Nevertheless, if it can be avoided the more succulent plants should not be grown in soil known to be infested by cutworms.

Clean culture is, of course, important. Weeds and rubbish afford excellent breeding places for cutworms as well as for many other insects.

THE LETTUCE PLANTLOUSE.

Macrosiphum lactucae Kalt. (*Nectarophora lactucae*, *Siphonophora lactucae*, *Aphis lactucae*).

The lettuce louse is probably to be found in every Illinois greenhouse where lettuce is grown. It often becomes very abundant, especially in the lettuce heads, and not only stunts the plants, but makes the product unsalable because it is impossible to free the heads thoroughly from the lice. I have also found this louse on celery out-of-doors, but never sufficiently abundant to do injury.

Its life history is the same as that of most other plantlice; that is, the viviparous female reproduces without the intervention of the male, and gives birth to living young. Each louse may produce 50 to 100 young, and because of this great reproductive capacity a greenhouse may be almost overrun before the presence of the insects has been noticed.

Natural Enemies.—Fortunately, this species, like most plantlice, is subject to the attacks of many parasitic and predaceous insects which do much to control it. They are seldom capable of holding it completely in check, however, and remedial measures must be resorted to.

Remedies.—Only remedies to be used in greenhouses need be mentioned, as this louse has not been found by us of economic importance elsewhere.

Fumigation is the only satisfactory remedy. The lice are usually within the heads, making it almost impossible to reach them with a spray; and at any rate the use of an effective spray would probably spoil the lettuce for the market. Tobacco or one of the tobacco extracts, or better, hydrocyanic acid gas, may be used as a fumigant. The latter is the more effective, and will also destroy the whitefly and the aphids of the cucumber, which plant is usually grown in the same houses with lettuce.

THE IMPORTED CABBAGE WORM.

Pontia rapae Linn. (*Pieris rapae*).

Occasionally the cabbage worm becomes abundant and destructive to greenhouse lettuce, and I have seen beds which were planted the last part of August or the first part of September completely ruined by it. It has been already sufficiently discussed as one of the cabbage insects (pages 6 and 7).

Methods of Control.—As arsenicals can not be used on lettuce, it is hardly probable that the cabbage worm in greenhouses can be successfully treated by any of the measures advised for its control out-of-doors (page 7). If there are cabbage gardens near a greenhouse, it is not advisable to plant lettuce until the middle or last of September. If, in spite of precautions, a bed becomes badly infested, the plants should be thoroughly sprayed with Paris green, and pulled up within two or three days, after which the bed may be replanted.

ONION.

With the possible exception of the potato, the onion is the most important garden product of Illinois and its insect enemies are the most difficult to control. In 1899, 2,563 acres were used for the growing of onions in this State, and the acreage has enormously increased since then. There are but two onion pests which are of general economic interest, the onion maggot and the onion thrips.

THE ONION MAGGOT.

Phorbia ceparum Meigen. (*Pegomyia cepetorum*, *P. ceparum*, *Anthomyia ceparum*).

Any one who has ever had anything to do with onion-growing is fully aware of the great damage done by the onion maggot (Fig. 26). As soon as the plant begins to sprout, the work of the maggot begins, and it is at this time that much of the damage is done, although it is not so evident then as later. Much of the trouble attributed to poor seed is really due to the maggot, which may attack and quickly kill the plants just as they appear above ground, or even sooner. The earlier the attack the greater the number of plants destroyed, since more will be eaten by the maggot.



Fig. 24—Onion Maggot, *Phorbia ceparum*, female and head of male. Length of body about three-sixteenths of an inch.

maturing early in spring, deposit eggs deep in the cracks and crevices of the earth, near the young plants. The minute maggots hatching two to four days later, more or less according to the prevailing temperatures, make their way to the bulb and begin feeding on the roots and the underground parts of the plant. They burrow within

The adult (Fig. 24) of this maggot is very similar to the common housefly in general appearance, except that it has a grayish thorax and is somewhat smaller. It is a near relative of the cabbage root maggot, already described, and the two insects, as well as their work, are much alike. The winter may be passed in any one of its various stages excepting the egg. Hibernating adults, or adults maturing early in spring, deposit eggs deep in the cracks and crevices of the earth, near the young plants. The minute maggots hatching two to four days later, more or less according to the prevailing temperatures, make their way to the bulb and begin feeding on the roots and the underground parts of the plant. They burrow within the bulb, causing the inner parts to decay. An infested onion may appear sound, but by pressure the rotten parts and the maggots may be forced out. When full grown, some two or three weeks after hatching, the maggots change to brownish oval puparia (Fig. 25) in the bulbs or in the earth not far from the onions in which they have been feeding. These puparia transform to adult flies in about two weeks, and the flies, in turn, deposit eggs for a second generation.



Fig. 25—Onion Maggot, *Phorbia ceparum*, puparium. Length about one-fourth inch.

Natural Enemies.—The onion maggot has a few parasitic enemies, but they are seldom numerous enough to hold it in check, and have little economic value in Illinois. Chickens and other domestic fowls are fond of this insect, but on a large onion farm, it would be too difficult and expensive to keep enough of them to be of much assistance.

Methods of Control.—As this insect often lives over the winter as a maggot or as a puparium in the onion bulb, it is of great importance that the

fields should be thoroughly cleaned up in fall, no onions being allowed to remain there over winter.

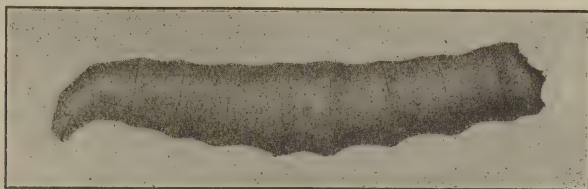


Fig. 26—Onion Maggot, *Phorbia ceparum*, larva, side view. Length about five-sixteenths of an inch.

As a rule, this pest is more abundant and destructive on comparatively sheltered areas than in open fields over which the winds have full play. This fact should be borne in mind in locating onion beds.

The amount and kinds of manure used may have an important influence on the damage done by this insect. Prof. C. G. Hewitt, of the University of Manchester, England, has recently shown²⁰ that *Anthomyia radicum*, a European species very closely related to the onion maggot, breeds freely in horse manure. It has often been noticed by entomologists and gardeners that fields which have been abundantly manured are worse infested than those where little manure has been used.²¹



Fig. 27—Onion Maggot, *Phorbia ceparum*, tip of larva, top and side views. Greatly magnified.

It is much easier to keep these maggots from infesting onions than to kill them after their appearance. The three best repellents and preventives which have been recommended from time to time are hellebore, tobacco dust and dry lime. The first two are discussed under remedies for the cabbage root maggot (pages 8 and 9) and on page 39. Dry lime may be applied in the same manner as tobacco dust. These substances either repel the fly or prevent the maggot from reaching the plant even though the eggs are deposited. They should be applied about the time the plants are sprouting or just as they appear above ground.

After plants have become infested it is often possible to kill the maggots before they enter the bulb by applying a contact insecticide. Carbolic acid emulsion and a decoction of hellebore (page 39) have given the best results. They should be applied as soon as the maggots are noticed, or at least before they enter the bulbs, otherwise it is impossible to reach them with any insecticide.

Old onions may be used as traps for the maggots, by placing them along the edges of the field in small piles in early spring, before the onion seed has been planted. The flies will be attracted to these decaying onions, which should be destroyed after infestation, particular care being taken to do this before any of the maggots have become adults.

Mr. F. A. Serrine²² suggests the following hand method: "To get at the onion maggot after the eggs have been laid, carefully lift all the infested onions and destroy the maggots by crushing or by dipping in kerosene. If this is done early in the season, when their work is first noticed, it will be no more of a task than the process of first weeding."

The use of commercial fertilizers, to force the plants rapidly at first, will greatly lessen the amount of injury by the maggot.

²⁰ On the Life-history of the Root Maggot, *Anthomyia radicum* Meigen, Jour. Econ. Biol., Vol. II, Pt. 2 (Aug. 31, 1907), p. 57; and on the Bionomics of certain Calyptate Muscidae and their Economic Significance, with especial Reference to Flies inhabiting Houses. Ibid, Pt. 3 (Dec. 11, 1907), pp. 86-87.

²¹ For tests with "blood and bone" see page 17.

²² Maggots and Smut in Onions. Rural New Yorker, May 12, 1900, Vol. 59, p. 334.

THE ONION THIRPS.

Thrips tabaci Lind.

In July or August one sometimes sees whitened onion plants in numbers sufficient to give the entire field a hoary look. This "white blast," as it is

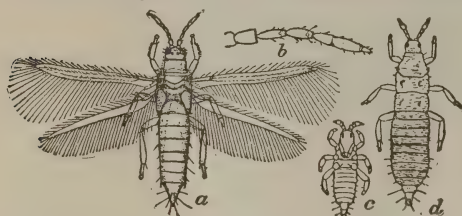


Fig. 28.—Onion Thrips, *Thrips tabaci*; a, adult; b, antenna of same; c, young larva; d, full grown larva. All highly magnified.

often called, is due to a tiny winged insect, the thrips of the onion, sometimes incorrectly called the "onion louse," which often appears in great numbers, feeding first at the axils of the leaves. It does not actually eat the leaves, for its mouth parts, which form an inverted cone projecting from the under side of the head, are not of the true biting type. It pierces the epidermis of the leaf, and by mov-

ing the tip of the cone backward and forward it makes an opening, through which it sucks the juices of the plant. Since this thrips is a general feeder, attacking many cultivated plants as well as weeds, it is of great economic importance, not only to the truck gardener but to the florist also. It is often injurious to cabbage and to cucumber plants in greenhouses.

Its eggs are deposited just within the leaf tissue. The young (Fig. 29, c) are very minute at hatching, elongate, and pale yellowish. The adults (Fig. 29, a) closely resemble the young in shape, but differ by their darker color, and usually by the possession of wings. There are several generations a year, the number varying according to the season. The winter is passed in either the larval or the adult stage.

Natural Checks.—The insect enemies of this thrips are of no importance, but the character of the weather has a noticeable influence on its abundance, wet weather being decidedly to its disadvantage.

Remedial Measures.—The standard insecticides for thrips are kerosene emulsion and whale-oil soap. Spraying must begin at the first appearance of the insects, and must be repeated in a week or ten days. The most effective indoor remedies are thorough and frequent fumigation with tobacco and tobacco extracts, or with hydrocyanic acid gas.

Clean culture is very important, since thrips hibernate on weeds and grasses along the edge of the onion fields. By plowing up all weedy and grassy land late in fall, after the thrips have left the onions, or by thoroughly burning over such land during the winter, the number of thrips can be greatly diminished. Entire communities should practice these farming methods, for otherwise fields properly cared for may become reinfested from those neglected.

GARDEN PEAS.

Garden peas are grown to a considerable extent by many of the market gardeners, and one insect pest, the pea louse, has been found to do great injury to this crop in Illinois.

THE PEALOUSE.

Macrosiphum pisi Kalt. (*Nectarophora destructor*, *Siphonophora pisi*, *Aphis pisi*).

This plant louse (Fig. 29) is common in all parts of the United States, and is a pest of some importance in Europe, its original home. Its life history is not unlike that of plantlice already described. The adult is about the size of a pinhead, or a little larger, pale green, and soft. It may be winged (Fig. 31) or wingless (Fig. 30). The winter is passed either in the egg or the adult stage, and usually on clover, from which it migrates to the pea in spring, sometimes multiplying enormously on this crop.

Natural Enemies.—Many parasitic and predaceous insects prey on the pealouse and materially aid in checking its rapid multiplication, the para-

sites not infrequently becoming numerous enough to control it completely. (Fig. 32.)



Fig. 29—Pealouse, *Macrosiphum pisi*, on stems of red clover. Natural size.

Remedial Measures.—Sprays of kerosene emulsion or whale-oil soap solution are probably the best remedies known. They should be applied at the first appearance of the lice, and continued as needed.



Fig. 30—Pealouse, *Macrosiphum pisi*, wingless viviparous female. Greatly magnified.



Fig. 31—Pealouse, *Macrosiphum pisi*, winged viviparous female. Greatly magnified.

The brush and cultivator method is also much used. With this in view the peas must be planted in rows at least two feet apart. As soon as the lice infest the vines, and at intervals subsequently, they are brushed from the vines and covered by a cultivator before they can get back. Brooms



Fig. 32—Pealouse, *Macrosiphum pisi*, empty skin after the emergence of a winged parasite. Greatly magnified.



Fig. 33—Pealouse, *Macrosiphum pisi*, attacked by fungus. Greatly magnified.

made of fresh-cut pine branches have been suggested for brushing the lice from the vines.

POTATO.

The potato is the most important vegetable grown in Illinois, both in acreage and value of the crop. Though it is attacked by a number of insect pests, none are of much economic importance in this State except the Colorado potato beetle, the wireworms, the flea beetles, and the potato plant louse. The stalk borer (*Papaipema nitela*) is also occasionally injurious to this crop. For a discussion of this insect see pages 34 and 35.

THE COLORADO POTATO BEETLE.

Leptinotarsa 10-lineata Say. (*Doryphora 10-lineata*).

This common and injurious species has doubtless caused greater damage to potatoes in Illinois than any other insect, and it is found on the vines



Fig. 34—Potato Beetle, *Leptinotarsa 10-lineata*: a, eggs; b, larvae, young and full-grown; c, pupa; d, adults; e, wing-cover of adult; f, hind leg of adult. Natural size except e and f.

in destructive numbers every year. It is a western species, its original habitat being the Rocky mountain region. Its native food consisted of wild plants closely related to the potato, and when potato culture reached its native prairies it promptly availed itself of the increased food supply thus afforded. It began its migration eastward by way of the potato fields about the year 1860, reaching Illinois some fifteen years later. Except in the Pacific coast region, it is now found generally distributed throughout the United States and Canada, wherever the potato is grown.

The yellow and black striped beetle (Fig. 34, *d, d*) passes the winter in the ground, and makes its appearance early in spring. It feeds at first on the young potato plants if these are at once available, or, if not, on some one of its wild food plants. The sexes soon mate, and the clusters of bright yellowish-orange eggs (Fig. 34, *a, a*) are deposited on the under side of the leaves. Each cluster may contain from 25 to 75 eggs, or even more, and individual beetles have been known to lay as many as 3,000 eggs under certain artificial conditions. The average number, however, is about 450.²³ The fleshy, grub-like larvæ (Fig. 34, *b, b, b*) hatch in four to seven days and at once begin to eat the potato leaves. They are dark red when hatched, but gradually become paler as they grow, with two rows of blackish spots along each side of the body. When two or three weeks old they go into the ground for pupation, emerging as beetles one or two weeks later. These beetles may feed and then go into hibernation, or eggs may be deposited for another generation. The number of generations is still in dispute, but there is probably but one as a rule, only a few of the beetles first to emerge laying eggs for a second generation the same year.

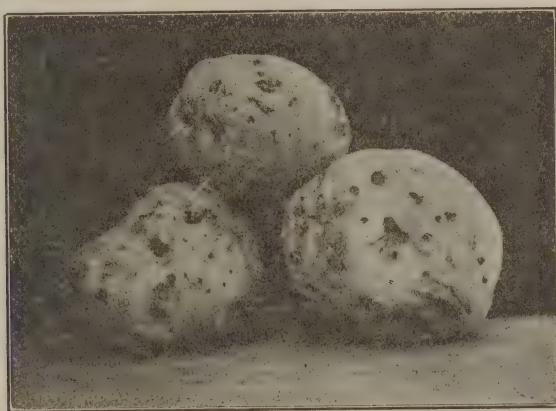


Fig. 35—Potatoes showing injury by wire worms, *Limonius confusus*.

Natural Enemies.—Insects enemies of the potato beetle are not uncommon, but it is doubtful if in Illinois they ever play any considerable role in reducing its numbers. Its commonest parasite in the vicinity of Chicago was a Tachina fly—*Phorocera rufilabris* V. d. W.²⁴ The white eggs of this fly were common on the backs of both beetles and larvæ—on the thoracic plate of the adult, and between the thoracic segments of the larva. The maggots hatching from these eggs enter the bodies of the beetles or the larvæ, soon killing them. Many predaceous enemies are known, including soldier bugs, robber flies, spiders, ground beetles, ladybirds, tiger beetles, rove beetles, and some native birds and the domestic fowls.

Methods of Control.—The two standard remedies for injuries by this pest are Paris green and arsenate of lead. In Illinois, dry Paris green, with or without lime or flour, is used by nearly all potato growers. It has the advantage of being easy to prepare and apply, but there are offsetting disadvantages which make it less desirable than Paris green in water. It is less adhesive than the fluid spray, and hence must be applied more frequently and more labor is required. The dry poison is very injurious when breathed into the lungs by the person applying it. Bordeaux mixture should always be added to Paris green when it is applied in water—as also to the arsenate of lead—for this compound spray is more effective against flea beetles, and is a remedy for blight. Furthermore, the lime in the Bordeaux unites with

²³ Further Biological Notes on the Colorado Potato beetle, *Leptinotarsa decemlineata* (Say), by Alec. Arsene Girault. Annals Ent. Soc. America, Vol. I, No. 2 (June, 1908), p. 158. Columbus, Ohio.

²⁴ Determined by C. A. Hart.

the Paris green, thus increasing its adhesiveness, and it changes the soluble arsenic to insoluble, thus preventing the burning of the foliage which often follows when Paris green is used alone. The method of preparation is given on page 37. The potato patch, and indeed the entire farm, should be kept free from weeds of the nightshade family, for the potato beetle can breed on these.

WIREWORMS.

Limonius confusus Lec.

But one kind of wireworm has been found by us common enough in Cook County to require special mention, but this single species is very injurious there to potatoes (Fig. 35, 36), radishes, onions, turnips, tomatoes, cabbage, corn, and horseradish. It burrows into or devours the roots and tubers of these vegetables, thus often completely ruining the crop. With the exception of the onion, tomatoes, cabbage, and corn, the plants above mentioned give no evidence above ground of the presence of wireworms, their attacks seldom weakening the plant, but merely disfiguring the marketable part.

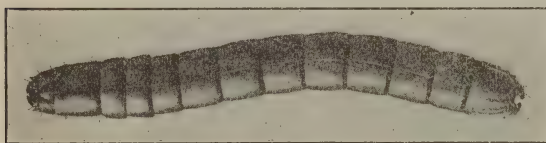


Fig. 36—Wireworm, *Limonius confusus*, larva. Length about three-fourths inch.



Fig. 37—Wireworm, *Limonius confusus*, tip of larva, seen from above. Greatly magnified.



Fig. 38—Wireworm, *Limonius confusus*, adult beetle. Length about three-sixteenths inch.

Remedial Measures.—Three methods of control are practiced; rotation of crops, fall plowing, and poisoned baits. Cropping for two years with some vegetable which is virtually immune, such as beans, peas, spinach, cucumber, melon, rhubarb, lettuce, or pepper, should rid the soil of wireworms.²⁵

Late summer or fall plowing is frequently resorted to in order to destroy the pupæ and beetles. The land should be cultivated thoroughly several times in the fall.

Trapping the adults by poisoned baits is a method sometimes used in the eastern states. Sliced potatoes, wads of green clover, or cornmeal dough, poisoned with Paris green, have been found effective.²⁶

These baits should be placed under boards in various parts of the field, and renewed once or twice a week during the spring and early summer.

²⁵ This list is given on the authority of those who have reported these plants to be practically uninjured by wireworms, even when the latter are present in the soil.

²⁶ Our own experiments the past year with poisoned baits for this insect were not sufficiently effective to pay for the labor and materials.

THE POTATO FLEABEETLE.

Epitrix cucumeris Harr. (*Crepidodera cucumeris* Harr.).

Potato leaves are often riddled with small holes as if they had been the target for a discharge of shot. Such injury is the work of flea-beetles. The life history and habits of the potato flea-beetle (Fig. 39) are essentially the same as those of the cabbage flea-beetle, which is discussed on pages 12 and 13.

Remedies.—The best remedy is spraying with Paris green, or arsenate of lead, and Bordeaux mixture, as recommended for the potato beetle (page 31). Potatoes may be thus protected against the potato beetle, the flea-beetle, and the blight. Other remedies applicable to this pest may be found on pages 12 and 13.



Fig. 39—Potato Flea-beetle, *Epitrix cucumeris*, adult. Enlarged as indicated.

THE POTATO PLANTLOUSE.

Macrosiphum solanifolii Ashm. (*Nectarophora solanifolii*, *Siphonophora solanifolii*).

The potato plantlouse is often a very troublesome species, densely infesting the tops of the plants and soon stunting or even killing them. It is so much like the notorious and destructive pealouse that the two species can not be distinguished without a closer examination than the ordinary observer is likely to make. Although commonly pale greenish, there is a red variety of this species which, during the summer, is often as abundant as the commoner green form. The life history and natural enemies of this aphid are similar to those of other plantlice already described.

Remedial Measures.—The only available remedies are those suggested for other plantlice; namely kerosene emulsion and soap solutions (page 38).

Clean culture seems to be of much importance, inasmuch as the eggs are deposited in fall on shepherd's purse and possibly on various other weeds.²⁷

Fall plowing and burning over grassy and weedy areas in the neighborhood of potato fields are certainly to be recommended; and Miss Patch further commends, as a precaution, the practice of burning old potato stalks, since belated specimens of the plantlice may possibly remain on them under certain conditions.

SPINACH.

Spinach is often attacked in fall by a plant louse which sometimes destroys entire fields.

THE OMNIVOROUS PLANTLOUSE.

Myzus persicae Sulz. (*Rhopalosiphum dianthi*, *Aphis dianthi*).

In the fall of 1908 my attention was attracted to the great abundance of a plantlouse infesting spinach on many truck farms near Chicago. This louse may feed on almost any plant, as the common name above given implies. Among the vegetables which it sometimes injures, weakening the plants and causing a curling of the leaves, are turnip, radish, celery, cabbage and cauliflower. It is impracticable to wash off these green lice after they become abundant, and the presence of thousands of them on the spinach renders it unsalable.

Remedies.—The only practicable remedy is thorough spraying with a contact insecticide which will not give a permanent odor or taste to the leaves. The standard tobacco or nicotine extracts (page 39) answer the purpose. It is very important that spinach should be closely watched, and that the plants be sprayed at the first appearance of the lice. The treatment should be repeated at intervals as may be necessary.

TOMATO.

Although not extensively grown in the truck gardens of Cook County, the tomato is of much importance in other parts of the State, particularly

²⁷ According to Miss Edith M. Patch. See "The Potato Plantlouse." Bull. Maine Agr. Exper. Station, No. 147 (Nov., 1907), pp. 247-248. Orono, Me.

as supplied to canneries. A stalk borer (*Papaipema nitela*) is the principal insect enemy of the crop in Cook County, and is no doubt the cause of more damage than is commonly charged to it. To the casual observer there is no indication of the presence of these insects when the plants wilt and die from its attack, and as a rule the gardener is at a loss to find the cause, the characteristic round hole in the stalk being easily overlooked. Occasionally the Colorado potato beetle, treated on pages 30 and 31, damages tomatoes soon after transplanting to the field.

THE STALKBORER.

Papaipema nitela Guen. (*Hydroecia nitela*, *Gortyna nitela*).

This borer, or "heart worm," as it is often called by corn growers, was found destructive to tomato and corn, and occasionally to potato, in a number of restricted areas during the past year. Other vegetables known to be injured by it are rhubarb, spinach, cauliflower, eggplant, and pepper.

The presence of this caterpillar in the tomato plant is indicated by the wilting or death and final breaking down of the top, and by the presence of a round hole in the side of the stalk, from which a brownish excrement is

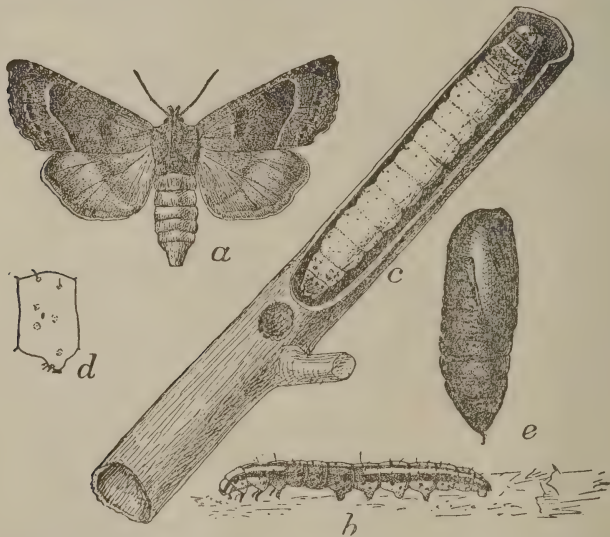


Fig. 40—Stalkborer, *Papaipema nitela*: a, adult; b, half-grown larva; c, mature larva in burrow; d, side of one of its segments; e, pupa. Slightly enlarged.

oozing. Upon careful examination of plants so injured a peculiarly striped larva (Fig. 40, b) will usually be found in the stalk. The following description is quoted from Professor Forbes.²⁸

The larva may be readily recognized "by the peculiar break in the striping of the body at the middle * * * (Fig. 40, b) giving it an appearance as if it had been pinched or injured there. It is about an inch long when full grown. The general color varies from purplish brown to whitish brown, according to age, and it is marked with five white stripes, one running down the middle of the back, and two on each side * * *. The stripes nearly vanish as the larva matures (Fig. 40, c). The head and top of the neck, and the leathery anal shield at the opposite end of the body are light reddish yellow with a black stripe on each side."

The young caterpillar first feeds within the stems of grasses or weeds, but as it becomes larger it is compelled to seek thicker stem plants, and it is at this time that it begins to infest garden vegetables. In northern Illinois, in 1908, half-grown larvae were found in tomato stalks the middle of

²⁸ Twenty-third Rep. State Ent. Ill., pp. 44, 45.

June, when fully half the plants in the field had been killed by them. The larva usually enters the stem near the base and burrows upwards. When full grown it changes into a reddish brown pupa (Fig. 40, *e*) within the stalk, usually below the original entrance hole, and later the grayish moth (Fig. 40, *a*) emerges. According to Prof. F. L. Washburn²⁹ the eggs of this moth are deposited in masses on the stem of the plant near its base. It is supposed that they are laid in grass lands in fall, and that they hatch the same season or the following spring.

Economic Procedure.—After plants have become infested, no remedy can be used to save those individual plants, and they should be pulled up and burned immediately to prevent the larvæ from entering other plants, and also to decrease the number of the borers for the next year.

In spring, vegetation around tomato, potato, and corn fields should be watched, and if it is wilting or dying it should be examined to learn if this borer is present, in which case the weeds should be cut and destroyed without delay.

Late fall plowing of infested fields is advised in order to bury the eggs, which, as already said, are supposed to be laid in grass or weedy land in fall, and all weeds, not only in the fields but along the roadsides adjoining them, should be destroyed at this time.

PREPARATION OF INSECTICIDES FOR USE AGAINST INSECTS INJURIOUS TO GARDEN AND HOTHOUSE VEGETABLES.

From the economic point of view insects are divisible into two classes; those which chew and swallow the tissues of the plant, and those which suck their juices. Insects of the first class—cabbage worms, potato beetles, and cutworms, for example—can usually be destroyed by one of the so-called stomach poisons enumerated below; but those of the second class—plant lice, thrips, the whitefly, etc.—are unharmed by such insecticides because they take their food from the interior of the plant, and so a contact insecticide must be used.

The classification in the following synoptical list of insecticides is based on their most obvious distinctions, and the subsequent treatment corresponds to the order of the list.

Dust or Liquid Sprays:

	PAGE.
Stomach poisons—for biting insects—	
Paris green, dry, with or without an adulterant.....	36
Paris green, liquid spray.....	36
Arsenate of lead.....	36
Resin-lime mixture, with a poison.....	36
Bordeaux mixture, with a poison.....	37
Contact insecticides—for sucking insects—	
Kerosene emulsion.....	38
Whale oil soap solution.....	38
Carbolic acid emulsion.....	38
Hellebore decoction.....	39
Insect powder (pyrethum or buhach).....	39
Tobacco and nicotine preparations.....	39
Lye sulphur wash.....	39

Poisoned Baits—for biting insects:

Poisoned bran mash.....	39
Poisoned lettuce or clover leaves.....	39

Repellents—for any insects:

Carbolic acid and lime.....	39
Tobacco dust.....	40
Lime, dry.....	40
Bordeaux mixture.....	37

²⁹ Preliminary Report upon Work with the stalkborers in Minnesota, 12th Rep. State Ent. Minn., p. 151, Dec., 1908.

Fumigants—for any insects:

Hydrocyanic acid gas.....	40
Carbon bisulfid.....	41
Sulphur	42
Tobacco stems.....	42
Nicotine preparations.....	42

PARIS GREEN—DRY.

Unmixed Paris green may be sprinkled upon plants, but the danger of burning the leaves is lessened by adulterating it with flour, land plaster, or air-slaked lime in the proportion of one pound of the poison to twenty-five pounds of flour or to fifty pounds of land plaster or lime.

Apply thoroughly and evenly with a hand "dust sprayer" early in the morning, when the dew is on the plants.

PARIS GREEN—LIQUID SPRAY.

Formula.

Paris green.....	1 pound
Unslaked lime	1½ pounds
Water	150 gallons

Slake the lime and add the Paris green, thoroughly mixing before adding the water. The mixture must be kept well stirred while it is being sprayed, and most spray pumps have an attachment for this purpose. The liquid spray is safer and more efficient than either of the dry mixtures previously mentioned.

ARSENATE OF LEAD.

Arsenate of lead can be made by properly combining lead acetate and arsenate of soda, but it is difficult to make a good grade of it, and unless large quantities are needed it is best to purchase standard brands, which are ready for use when dissolved in water.

The price of arsenate of lead is less than that of Paris green, but as one must use two to three times as much of it to secure a desired result, it is slightly more expensive as an insecticide than Paris green. This fact is offset, however, by the following advantages which arsenate of lead has over all other arsenicals; it is much more adhesive, remaining on the foliage for a period during which two or three sprayings with Paris green would be necessary; it remains in suspension better; it shows on the foliage; and it is harmless to vegetation, this last fact being of special advantage when the more tender plants are sprayed.

Care should be taken to obtain a good grade, for there are many worthless brands on the market. Usually a good grade can be obtained from any reliable wholesale druggist. As the strengths of the various brands differ, the gardener should follow the directions accompanying the arsenate he is to use.

RESIN-LIME MIXTURE.

The resin-lime mixture serves as a stock solution in which poisons may be added. It is valuable chiefly because of its adhesive properties, being for this reason well suited to smooth leaves, such as those of the cabbage. It has the disadvantage, however, that considerable time is necessary for its preparation, and that it is especially liable to clog the spray nozzle. It is prepared as follows:

Stock Solution.

Pulverized resin.....	5 pounds
Concentrated lye.....	1 pound
Fish oil, or any animal oil except tallow.....	1 pint
Water	5 gallons

Place the resin, oil, and a gallon of hot water in an iron kettle and heat until the resin is softened, after which the lye should be added to the heated mixture and the whole thoroughly stirred. Then add the remaining four gallons of water and boil for about two hours, or until it will unite with cold water and make a clear, amber-colored liquid. If there is less than five gallons of the preparation, add water enough to make that quantity. This stock solution will keep indefinitely, and the quantity needed for the whole season may be made up at one time.

Preparation for Use.

Stock solution.....	1 gallon
Water	16 gallons
Milk of lime ⁸⁰	3 gallons
Paris green.....	$\frac{1}{4}$ pound

First add the water to the stock solution, mixing thoroughly; then add the milk of lime; and, finally, add the Paris green, previously stirred up with water to form a thin paste. The whole mixture must then be thoroughly stirred. This preparation should be made up as needed, for if allowed to stand any considerable time it will settle, and will also gum up the pump valves and the nozzles.

BORDEAUX MIXTURE AND PARIS GREEN.

Bordeaux mixture is primarily a fungicide; but it is also useful as a repellent against some insects, and with Paris green or arsenate of lead it makes an excellent combination spray to be used when both fungi and leaf-eating insects are to be dealt with on the same crop.

Various strengths of the Bordeaux are used by the vegetable gardener according to the plants to be sprayed. Those in commonest use are often conveniently designated as 4:4:50, and 6:6:50. The significance of the figures is evident from the following 4:4:50 formula:

Copper sulphate.....	4 pounds
Quicklime	4 pounds
Water	50 gallons

For such plants as asparagus, tomatoes, and melons, the 4:4:50 strength is used; and for the potato and related plants, the 6:6:50.

To make the Bordeaux mixture, dissolve the copper sulphate in about 20 gallons of water—best done by placing the sulphate or bluestone as it is



Fig. 41—Method of preparing Bordeaux mixture by hand.

often called, in a gunny sack or other stout cloth bag and suspending it in the water. It will dissolve in a day or so, and if covered to prevent evaporation it will keep indefinitely. If less than 50 gallons of the Bordeaux mixture is needed, or if the solution is wanted immediately, the bluestone

⁸⁰ Milk of lime is made by slaking stone lime and adding sufficient water to make a thin whitewash.

may be readily dissolved in hot water.³¹ In another vessel slake the lime, adding the water slowly, to obtain a smooth, creamy liquid, using barely enough water to cover the lime after it has settled. In this condition, if evaporation is prevented, it will, like the copper sulphate solution, keep indefinitely.

When ready to spray add enough water to each stock solution, separately, to make 25 gallons, stir each thoroughly, and then mix the two together. This may be done by having the barrels containing the two solutions on a high support, with plugs near the bottom so that both solutions can be run into a third vessel below, the operator stirring the fluids as they unite. Or, if such an apparatus is not obtainable, the mixture may be made by pouring the two fluids from buckets (Fig. 41).

For the combined fungicide and insecticide, add five or six ounces of Paris green, previously made into a paste with water, to fifty gallons of Bordeaux mixture, and thoroughly stir. If arsenate of lead is used in place of the Paris green, about four or five times as much will be required.

Although the separate solutions of the copper sulphate and of the lime are stable, they are not so when combined, and therefore only the quantity to be used at the time should be made up.

KEROSENE EMULSION.

Stock Solution (66 per cent kerosene).

Soap ³²	½ pound
Kerosene	2 gallons
Water	1 gallon

If hard soap is used, cut it into fine shavings and dissolve in boiling water, after which remove from the fire and immediately add the kerosene and thoroughly mix. This may be done most easily by churning for about ten minutes with a force pump, the nozzle being turned back into the liquid; or, in the absence of a pump, the liquid may be turned from one bucket to another for fully ten minutes, holding the bucket high so as to give force to the falling liquid. When thoroughly emulsified it will have the consistency of thick cream, and the oil will not separate out. There is great danger of injuring the plants if the mixture is not well and thoroughly made.

For spraying vegetation the stock solution should be diluted to the desired strength. For a 5 per cent emulsion add 37 gallons of water to 39 gallons of the stock solution; for a 10 per cent emulsion add 17 gallons of water to the same; and for a 15 per cent emulsion add 10½ gallons.

It is desirable to use soft water both for the stock and as a diluent, but if this is not obtainable the water should be softened by adding lye or soda.

The emulsion should be applied to plants with a spray pump, and in a fine mist-like spray. For most insects a 10 per cent emulsion is strong enough.

WHALE-OIL SOAP SOLUTION.

Whale-oil soap is an effective insecticide for plantlice and other soft-bodied insects. For use, dissolve one pound of the soap in six to eight gallons of hot water.

CARBOLIC ACID EMULSION.

Carbolic acid emulsion is a contact insecticide, and also acts as a repellent, being chiefly used for the treatment of root-infesting insects.

Stock Solution.

Hard soap (preferably "Ivory" or "Tak-a-nap")	1 pound
Soft water	1 gallon
Crude carbolic acid	1 pint

Dissolve finely shaved soap in boiling water, add the carbolic acid, and churn as for kerosene emulsion. For use, one part of the stock solution is diluted with thirty to forty parts of water.

³¹ Copper sulphate, either dry or in solution, corrodes iron, and a wooden, earthen, brass, or copper vessel should be used.

³² Either hard or soft soap may be used. Whale-oil soap and "Tak-a-nap" soap have given excellent results.

HELLEBORE DECOCTION.

For use against root maggots, this decoction is prepared by steeping two ounces of white hellebore in one gallon of hot water for 30 minutes. For insects infesting the foliage, one ounce of hellebore to two gallons of water is sufficient. Hellebore very soon loses its insecticidal properties by exposure to the air, and care should be taken to obtain only such as is known to be fresh.

INSECT POWDER (PYRETHRUM, OR BUHACH).

Pyrethrum, or insect powder, as this insecticide is commonly called, is of special value for killing certain kinds of insects, and it has the advantage of being harmless to human beings and the higher animals. On the other hand, its expense prohibits its use on a commercial scale, and it quickly loses its virtue when exposed to the air. If used in a dry form it should be mixed with twice its weight of common flour, and kept in a tightly closed vessel for 24 hours before using. It may be applied with a dust sprayer or some sifting apparatus. A decoction of pyrethrum may be made by mixing one ounce of the powder with enough water to form a thin paste and allowing it to stand several hours, after which sufficient water should be added to make two gallons. This is less effective than the dry powder.

In purchasing pyrethrum, only hermetically sealed cans of it are safe, for the reason already given, but if they can not be obtained care must be taken to buy only an absolutely fresh article.

TOBACCO DECOCTION AND NICOTINE PREPARATIONS.

Tobacco decoction, although not so effective as some of the above-mentioned contact insecticides, is still used by many for killing soft-bodied insects, such as plantlice. It is prepared by steeping tobacco stems in hot water at the rate of one pound to two to three gallons.

More reliable than the above, are various commercial preparations which likewise have nicotine as their active principle. (See page 42.)

LYE-SULPHUR WASH.

This contact spray is said to have particular value against the red spider. It is prepared by mixing five pounds of flowers of sulphur with cold water and then adding to this sulphur paste two and a half pounds of pulverized caustic soda. Water is added from time to time, to prevent burning, until a concentrated solution of five gallons is obtained. One gallon of this stock solution is sufficient for 25 gallons of spray.

POISONED BRAN MASH.

Bran	16 pounds
Paris green.....	1 pound

Slightly dampen the bran and add the Paris green, mixing until every particle of the bran bears some of the poison. The bran should be barely wet enough to make the powder adhere to it, as experiments in green-houses strongly indicate that a soggy mash is not freely eaten by cutworms. A little salt in the water used is said to give the mixture additional relish.

POISONED LETTUCE OR CLOVER LEAVES.

Small lots of lettuce or clover are poisoned with Paris green, either dry or suspended in water, and the poisoned vegetation is then cut or mowed, and scattered over the infested tract (see page 24). This and the poisoned bran mash seem to be about equally effective.

CARBOLIC ACID AND LIME.

A coating of the soil at the base of the plants with carbolic acid and lime has been recommended by Dr. John B. Smith³³ as "the most effective material tested," in his experiments against the onion maggot in New Jersey.³⁴ To make the mixture, slake three pints of lump lime in a gallon of water, and add one tablespoonful of crude carbolic acid. When applied properly along the rows with a sprinkling can or spray nozzle, a thin crust will form

³³ The Cabbage and Onion Maggots. Bull. N. J. Agr. Exper. Station, No. 200 (Feb. 12, 1907), pp. 16-19.

³⁴ For reference to our own experience with it see page 10.

on the ground around the plants, which is said to serve the same purpose as the tarred felt-paper protectors described on page 10.

TOBACCO DUST.

Tobacco dust has been recommended as a useful repellent, particularly against such insects as root maggots and cucumber beetles. It has the further advantage of serving as a contact insecticide and as an excellent fertilizer. Indeed, it is said that its value as a fertilizer alone is sufficient to cover its cost.

For leaf-eating insects it is dusted on the leaves early in the morning, while the dew is on. For root-feeding insects it is sprinkled along the rows at the base of the plants, preferably when the soil is moist.

DRY LIME.

Fresh air-slaked lime or quicklime when used as a repellent for root maggots is sprinkled along the rows close about the plants, and acts similarly to the carbolized lime application. As some insects of economic importance are attracted to manures, the latter should be sprinkled over with lime where there is danger of infestation by insect pests.

Dry lime, especially when fresh, is strongly caustic, and is therefore valuable as a contact insecticide for slugs, plantlice, and soft-bodied insects generally.

HYDROCYANIC ACID GAS.

Hydrocyanic acid gas is doubtless the most powerful and effective fumigant known. Indeed, many are afraid to handle the deadly gas; but it can be used with perfect safety if proper care be taken.

It is impossible to give a set formula for its use, owing to differences in the structure of greenhouses. In those of average tightness I have used it on cucumber plants, without injury to them, at a strength of 1 ounce of potassium cyanide to 3,000 cubic feet of space—fumigating in the evening, and keeping the house closed over night.

The materials necessary for fumigation with hydrocyanic acid gas are potassium cyanide (98 to 99 per cent pure), commercial sulphuric acid, and water; and the requisite utensils are half-gallon or gallon jars—stone, earthen, or granite—and a supply of ordinary small paper bags.

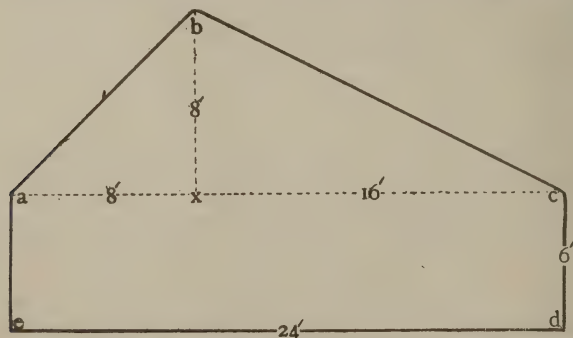


Fig. 42—Diagram illustrating determination of cubic contents of greenhouse.

The number of cubic feet in the house should first be accurately calculated. The method of doing this may be illustrated by a simple computation based on the dimensions given in the accompanying figure, the understanding being that the length of the greenhouse is 100 feet. (Fig. 42.) The cubic contents of the rectangular section of the house, $a c d e$, equals $24 \times 6 \times 100 = 14,400$ cubic feet; that of the triangular section $a b x$, equals $8 \times 8 \times 100 \div 2 = 3,200$ cubic feet; and that of the other triangular section, $b c x$, equals $8 \times 16 \times 100 \div 2 = 6,400$ cubic feet. The cubic contents of this house are, therefore, $14,400 + 3,200 + 6,400 = 24,000$ cubic feet. Assuming this house to be of no more than the average tightness, we may safely use potassium cyanide at the rate of one ounce to every 3,000 cubic feet of space, and

24,000 divided by 3,000 gives 8 as the number of ounces required in this illustrative case.

The next procedure is to prepare the materials for use and to place the jars in the house. For every ounce of the potassium cyanide used, two ounces of sulphuric acid and four ounces of water are required. Two ounces of the cyanide is about the right quantity for each jar, therefore, for a house of the above dimensions four jars should be placed at equal intervals along the aisles, and the eight ounces of cyanide divided into four equal parts, and each part put into one of the paper bags. These are used not only for convenience in handling the cyanide when placing it in the jars, but also because they slightly delay the action of the sulphuric acid upon it, thus giving the fumigator ample time to leave the house before the reaction occurs. The jars being in place and the cyanide properly weighed and bagged, the next step is to close all the ventilators in order to prevent any avoidable escape of gas. The water—four liquid ounces to every avoirdupois ounce of cyanide—is then placed in each jar, the sulphuric acid—half as much as the water—is added, and as soon after as possible the bags of cyanide should be put into the jars and the house vacated immediately. Doors should be locked and labels posted indicating the danger. No one should enter the house until it has been thoroughly aired by opening the side doors, and, if convenient, the ventilators also. It is best to fumigate in the evening, keeping the house closed till morning. I have never found a greenhouse so tight that the fumes would remain in it in dangerous quantities all night; nevertheless, it is safest to air the house well before entering.

Precautions and Miscellaneous Directions.—As cyanide of potassium is a powerful poison it should be handled as little as possible. It should be kept in tightly closed cans or jars, plainly labeled, where it will be inaccessible to persons not acquainted with its poisonous properties. Use only a grade 98 to 99 per cent pure. It may be obtained in either granulated or lump form, the former being the most convenient for use in fumigation.

Sulphuric acid should not come in contact with the hands or with the clothes, as it will severely burn the flesh and ruin the clothes. It should not be placed in metal receptacles, as it will soon eat them through.

Fumigate in the cooler parts of the day, and avoid, if possible, a temperature above 60° or 65° F., since at a higher temperature the plants are more liable to be injured.

The foliage of plants to be fumigated should be perfectly dry, otherwise it will absorb the gas and be burned.

The best shaped jar, when using two ounces of cyanide to a jar is one four or five inches in diameter and about nine inches high. If more cyanide is to be used in each receptacle larger jars must be used.

Always put the water into the jars first, adding the acid later. Never pour water into the undiluted acid.

After placing the sulphuric acid in the jars the bags of cyanide should be put in as soon as possible, for any delay will interfere with the proper reaction of the chemicals owing to the fact that the acid acts most powerfully when it first unites with the water. The manner of putting the bags into the acid is also important. They should not be held a foot or more above the jars and dropped in, as the bags may be thrown out by the reaction. Each bag must be carefully laid in the jar, but the fumigator must not lean over the jar as he does it, nor remain near it to watch the reaction. After a few fumigations the operator often becomes less attentive to the prescribed directions and precautions. This tendency should be promptly checked, the utmost care and caution being uniformly necessary.

CARBON BISULPHID.

Carbon bisulphid is used as a fumigant for aerial plantlice, for rootlice and root maggots, and for weevils in seeds. For methods to be followed in treating the first class mentioned, see page 11. For rootlice and root maggots, a small hole is made in the ground near the plant, and into it is poured a small tablespoonful of the liquid. The hole is then promptly closed and the maggots are killed by the fumes. The carbon bisulphid should

not be poured on the plant above ground nor directly on the roots. For weevils, the seed should be placed in a tight box or bin, space being left at the top for a pan or other shallow dish for the carbon bisulphid. This should be used at the rate of one ounce to 60 cubic feet of box space, and the box should be kept closed for 24 hours. The vapor given off being heavier than air, descends, killing all insects present without injuring the seed.

As the fluid is inflammable, and its vapor, mixed with air, somewhat explosive, precaution should be taken never to permit a spark of fire to come in contact with it.

Carbon bisulphid may be obtained at drug stores for 20 to 35 cents a pound. A grade known as "Fuma Carbon Bisulphide," which is fully as effective for fumigation as the ordinary grade sold by druggists, is manufactured by E. R. Taylor, Penn Yan, New York, and furnished in 50 or 100-pound cans at 10 cents a pound.

SULPHUR.

Thorough cleaning of greenhouses for the eradication of insect pests should be practiced by the greenhouse gardener when the houses are empty, and fumigating with sulphur is one of the best and easiest means to this end. About one pound of sulphur should be burned to every 2,000 cubic feet of space, after which the house should be kept tightly closed for 24 hours, or longer if convenient. It is needless to say that at this strength all plants, as well as insects, will be killed.

For fumigating houses containing growing plants, evaporate a small quantity of sulphur in a suitable receptacle over a lamp or oil burner, taking care that it does not catch fire; or the steam pipes may be painted with a sulphur paste made by mixing sulphur and water. A paste is sometimes made in which the sulphur is mixed with oil instead of water. Sulphur is not only valuable as an insecticide, but useful in controlling mildew.

TOBACCO STEMS.

Though tobacco stems for fumigation purposes have been largely superseded by the recent introduction of various nicotine extracts, they are still used, and are recommended for killing plantlice and thrips, especially when easily obtainable at a reasonable price.

Three piles of stems, of about half a bushel each, are used to every 100 linear feet of the house, the piles being dampened to prevent rapid burning. These are set on fire in the evening, when the building is left for the night. The house must be kept as tightly closed as possible until morning. Frequent fumigations—at least weekly—are necessary to obtain the best results.

NICOTINE PREPARATIONS.

Many nicotine preparations are now on the market under such trade names as "Nicoteen," "Nicoticide," "To-ba-ken," "Nico-Fume," etc. Most of them contain 25 to 45 per cent of nicotine, and are more effective, though more costly, than tobacco stems or tobacco dust. They may be used as fumigants in various ways. The commercially prepared fumigating papers are suspended in strips and lighted when ready to fumigate. Dry preparations are placed in shallow dishes and ignited. It is sometimes advisable to add a few drops of kerosene to facilitate their burning. The extracts are evaporated over a lamp, or, like the sulphur paste, are painted on the steam pipes. They evaporate or burn slowly, producing a powerful vapor. As a rule it is best to fumigate in the evening, keeping the houses closed over night. Most insect pests of the greenhouse may be controlled by thorough and oft-repeated fumigations with one of these extracts.

Illinois Farmers' Institute

CIRCULAR NO. 8

1914



Report of a Conference Between the Board of Directors
of the Institute and the Representatives of
Large Business Interests

TIME—December 1, 1913

PLACE—Gray Room, Sherman Hotel, Chicago, Illinois

H. A. McKEENE, Secretary

Illinois Farmers' Institute

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SPRINGFIELD, ILL. •
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1914

ILLINOIS FARMERS' INSTITUTE.

Created by Act of the Thirty-Ninth General Assembly.

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Ralph Allen	J. P. Mason	A. N. Abbott	C. V. Gregory	Frank I. Mann
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ANNUAL DINNER BOARD OF DIRECTORS ILLINOIS FARMERS' INSTITUTE

GREY ROOM, HOTEL SHERMAN, CHICAGO, MONDAY,
DECEMBER 1, 1913, RECEPTION, ASSEMBLY HALL,
FIRST FLOOR, 6:00 P.M., DINNER 6:30

MENU

Celery	Blue Point Oysters Olives	Hickory Nuts
Cream of Fresh Peas	Aux Croutons	
Lake Superior Trout	Au Champagne	
Cider	Doughnuts	
Broiled Chicken	Brown Gravy	
Mashed Potatoes	Grilled Sweet Potatoes	
	Apple Sauce	
Combination Salad		
Pumpkin Pie	Cheese	
	Coffee	

PROGRAM

TALKS—TEN MINUTES EACH

PRESIDENT A. N. ABBOTT, *Presiding*

"Desirability for and Methods of Co-operation Between Farmers and Corporate Interests From the Farmer's Standpoint," Dr. Eugene Davenport, Dean of College of Agriculture, University of Illinois, Urbana, Ill.

"Desirability for and Methods of Co-operation Between Corporate Interests and Farmers From the Standpoint of Corporate Interests," C. W. Boynton, Engineer in Charge, Universal Portland Cement Company, Chicago, Illinois.

"The Illinois Plan for Permanent Agriculture," Frank I Mann, Gilman, Illinois.

"The Policy of the American Steel & Wire Company With Reference to the Improvement of Agricultural Methods," Frank Baackes Vice-President, American Steel & Wire Company, Chicago, Ill.

"Improvement in Efficiency and Design Through Co-operation Between the Manufacturer of Farm Machinery and the User," C. V. Gregory, Editor Prairie Farmer, Chicago, Ill.

"Maintaining Friendly Relations Between the Manufacturer of Farm Machinery and the User," J. B. Bartholomew, President Avery Manufacturing Company, Peoria, Ill.

"Possibilities of Concrete on the Farm," Edward M. Hagar, President Universal Portland Cement Company, Chicago, Ill.

"Problems in Beef Production," Prof. Herbert W. Mumford, Head of Animal Husbandry Department, University of Illinois, Urbana, Ill.

"The Diminishing Supply of Live Stock and the Remedy," Arthur Meeker, General Manager Armour & Company, Chicago, Ill.

"The Interest of Railroads in Improved Agricultural Conditions," A. C. Johnson, Passenger Traffic Manager, Chicago & North-Western Railroad Company, Chicago, Ill.

"Up State vs. Down State," James Keeley, General Manager Chicago Tribune, Chicago, Ill.

"Electricity for the Farm," Samuel Insull, President Commonwealth-Edison Company, Chicago, Ill.

"Agricultural Credits From the Farmer's Standpoint," Hon. A. P. Grout, Winchester, Ill.

"Agricultural Credits From the Banker's Standpoint," E. D. Hulbert, Vice-President Merchants Loan and Trust Co., Chicago.

PRESIDENT'S ADDRESS

HON. A. N. ABBOTT, Morrison, Illinois

GENTLEMEN: This is a very unusual gathering; it is unique. Perhaps its like never before was assembled in the city of Chicago, or elsewhere.

There is so much that could appropriately be said on this occasion, that considering the element of time, I scarcely know what to say and what omit.

First, however, I wish to thank our distinguished guests for their presence here tonight, and trust we all are here in a spirit of willingness for a closer relation and better acquaintance with each other; not so much for our individual and selfish interest, but in a higher way to consider questions for the general good.

Let us all talk facts tonight, as we see them. I believe I will not be accused of attempting an originality, when I say that agriculture is the foundation of our national prosperity. That is a fact; there may be those who wish it were otherwise and that the fisheries, or the mines, or the forests were our principal source of wealth, but they are not, and so far as we now can see agriculture will always be the base on which we will build.

Another fact: The great business interests of the country are in the hands of comparatively few corporations; this too is a fact. There may be those who deplore this conditions and wish it were otherwise, but it is the truth and so far as we now can see this condition will continue indefinitely. The most of us, I think, believe in the general principals of evolution, and in the struggle for existence, the fittest survive. On this theory there must be a good reason for corporate control. Unquestionably the answer is that there is economy and efficiency in a monopoly when competition requires the duplication of investment in a plant and operating expenses.

When I was a boy, three competing creameries sent their wagons daily, by my father's farm, collecting cream, when one wagon could equally well have served the community. In this case there was the unnecessary expense of two teams, two wagons, two drivers, two buttermakers. There was the needless investment of capital in building, equipping and operating two useless creameries. The people of that community paid dearly for the competition they enjoyed and which was supposed to be the life of trade. However, corporations which enjoy a monopoly should be subject to regulation.

A third fact: We must not loose sight of the human factor; every movement which is not for the public good is not for the public good, and so closely interwoven are the fabrics of society that whenever one portion receives more than it is justly and fairly entitled to some other portion must receive less, whether it be in labor or products, and the whole social body,

sooner or later must suffer. When the farmers sold their crops for less than the market cost of the elements of fertility, they contained, not to mention the item of labor, the cost of living was not high, but society, eventually will pay for this unrequited toil and loss of fertility.

These three prime facts in the business world, let us not forget. When a man launches on a business venture, he considers the factors relating thereto. He must take things as he finds them, not as he may wish they were. You can realize on facts, but not on desires; dreams have no cash value.

You gentlemen, of large business interests, study carefully every factor along certain lines that enter into the production and organization of your business; you know to a fraction the energy to be developed by a ton of coal and the service to be secured from a quart of lubricating oil, but some of you, I fear have not given the consideration to the farmer and his problems in their relation to your interests which his importance justifies.

You each have your problems peculiar to your interests, while in his way the farmer has them all. The banker, the packer, the manufacturer of cement, of wire, of farm machinery, the questions of transportation all are his.

To attain the highest agricultural development, which, at the same time, is for the best interest of everyone, it is absolutely essential that the farmers have assistance and co-operation from the outside. They have problems which they can not solve alone; there are conditions which they do not control.

There are two ways to secure this outside assistance; one is to wring from unwilling corporations, by statutory enactment, decisions of courts and rulings of commerce and utilities commissions the required aid. The other way by concessions and co-operation. While monopolies are properly subject to regulation, happily it is the tendency of the time to so conduct their business that less regulation is necessary.

You, gentlemen, are strongly entrenched behind financial bulwarks. The farmers are strong numerically, and while we need your co-operation to improve the agricultural condition, the political storm clouds gather around you and the time draws near when in all likelihood the farmers will be the arbiters of industrial questions, and may be called upon to decide even corporate existence.

The agriculture of this country is undergoing an interesting readjustment; for the first time in our history consumption has overtaken production; the era of low prices for farm products for any considerable period of time is gone and forever the day of good cheap living is past. Things agriculturally are looking up in every way, financially, socially, educationally, politically. It seems to me that the good will of the farmers would be a valuable asset for any business concern, and the way to get anything is to go after it.

Out of consideration for our guests it seems proper that they be given a brief outline of the aim, scope and organization of the Illinois Farmers' Institute. It stands for better farming, more and better live stock, better homes, better schools, better roads and better citizenship. It knows neither political faith or religious creed. Every citizen of the State is welcome to attend the institutes and participate in the discussions. The State organization consists in one director from each Congressional District, and five ex-officio directors, who are the Dean of the College of Agriculture, the President of the State Board of Agriculture, the President of the State Dairymen's Association, the President of the State Horticultural Society and the Superintendent of Public Instruction.

The great work of the institute consists in the dissemination of information, gathered from practical farmers, experiment stations, and elsewhere. This is done by means of press articles, bulletins, reports and institutes. More than 400 institutes will be held this fall and winter in various parts of the State to which the State Institute will furnish speakers. Seventy-two press articles have been sent to 240 publications having an estimated circu-

lation of one million five hundred thousand. The attendance at the 400 institute meetings is estimated at 200,000.

I believe that I am quite within the facts when I say that the Institute is popular in the rural districts, and as a moulder of sentiment a single incident will illustrate: In 1905 the State Highway Commission was established by an Act of the General Assembly. Some two years later a joint meeting of the executive and legislative committees of the Illinois Farmer's Institute was being held at Springfield, when the Governor's private secretary presented the compliments of the Governor and requested that the committees give an audience to the Governor and the Highway Commission, which request was duly granted. Thereupon, Governor Deneen and the Commission, consisting of President James, of the State University; LaFayette Funk, of Bloomington, and Joseph Fulkerson, of Jerseyville, with State Engineer Johnson, came to the room. Governor Deneen was the spokesman, and said the State Highway Commission was organized to do good for the State but up to that time they were unable to get a foot hold, having met, in their tours over the State, only rebuffs, criticism and hostility. He appealed to the Farmers' Institute for assistance. The next day the following resolution was adopted:

"The Directors of the Farmers' Institute have carefully investigated the aim, scope and personnel of the State Highway Commission and find the aim to be a laudable one, the scope properly restricted and the personnel of the Commission above reproach, therefore be it

Resolved, That the Illinois Farmers' Institute heartily commends the State Highway Commission to the confidence and loyal support of the people of the State."

This resolution was taken up with the various county organizations of the State and as a result requests were made to the State Highway Commission for speakers, from more than 90 counties of the State, and from that time the Highway Commission has had requests for more speakers than they could furnish and their office has been flooded with work.

We are here tonight to some extent in an experimental way. We request of you to express your thoughts in your own way, let them lead wheresoever they may, and should any one say things that appear to be plain, let it be understood that it is not for the purpose of giving offense, but rather that good may come.

My great desire is when we shall separate that we can each of us say that we have drunk moderately, kept good natured, and that the evening was an enjoyable one and profitably spent, and that much good may result.

It really is not the intention to exhaust all of the subjects before us this evening. We want something left for a future conference in case it shall be desirable.

The first speaker on the program is Dean Davenport, Dean of the College of Agriculture of the State University. To him has been assigned the difficult subject, "Desirability For and Methods of Co-operation Between Farmers and Corporate Interests From the Farmer's Standpoint." He is so well known that he does not require an introduction. His great peculiarity consists in always saying something when he talks.

DESIRABILITY FOR AND METHODS OF CO-OPERATION BETWEEN FARMERS AND CORPORATE INTERESTS FROM THE FARMER'S STANDPOINT

DR. EUGENE DAVENPORT, University of Illinois, Urbana, Illinois

MR. CHAIRMAN AND GENTLEMEN: The reason that corporate interests should be thinking of agriculture is because agriculture has come to be very much more than the business of the individual farmer.

It is not as a favor to the individual so much as it is a matter of necessity that all people, whose interests touch agriculture at any point, should begin to study its needs. In other words, the farmers are serving the public as any other body of interests serve the public.

The farmers do not constitute a corporate body and cannot because of their very number, but the nature of the service is the same as that of any other large business conducted for public welfare.

The need for a better understanding and the need for a better agriculture, and more efficient agriculture, is now, for the first time, apparent to everybody, and everybody is trying to take a hand at it. They are trying to help the farmer to farm better, and that leads me to remark that the great need just now is not so much that the bankers, the railroad men, the cement men and the other large interests, shall undertake to teach the farmer how to farm, as it is that we, together in meetings like this tonight, shall undertake to explore that territory that lies between agriculture and these other interests.

We do not know where our interests touch and cross. I discover that as soon as the large interests become interested in farming they begin at once to teach the farmers how to conduct their business and there are over a dozen enterprises of that kind in the country now. In this they fail of their best purposes.

I will illustrate by two or three cases that have come to my attention recently. I met on the train, going to Washington, last week, an agricultural representative for one of our western railroads, and he asked me how he might advance the work that he was engaged to do. I asked him what he was thinking of doing. He said: "I am going to establish a lot of model farms along our line." I said, "Don't you do it; you are a railroad man." He was a graduate of an agricultural college and he did not know of any other way to justify his position except to teach the farmers to raise more crops.

I told him about a friend of mine who ran a fruit farm of forty acres within two miles of a station, but he had to haul his fruit sixteen miles to ship it, and it took the whole neighborhood to harvest the fruit crop of that forty acres. This friend of mine succeeded in getting one load loaded at about eleven o'clock at night and after sleeping two hours started for market.

He was a farmer but for six weeks he was running a transportation business, with a railroad almost before his very door.

It was the business of the railroad to know whether that should be a fruit producing district, and if it was, to induce ten men, on forty acres each, or four hundred acres to produce fruit while the railroad attended to the transportation end of the farmer's business. I said to the railroad man: "Your business lies at this point." A few days afterwards the public press reported the incident of President Ingalls buying peaches in Kansas City at five cents apiece, and next morning saw them fed to the hogs in sight of the car windows only because the railroad did not provide the kind of transportation needed along its line.

The farmers can produce the crops if they can get rid of them, but when the farmer has to be a transportation agent for a commodity that has to be handled by wagon, with a railroad right at his door, but which does not provide him transportation facilities, neither the railroad nor the farmer will make very much money.

We know how hard it was to get the fruit industry started in California. We know that year after year, after fruit growers had put out large orchards and raised several crops, they were unable, because of lack of shipping facilities, to get their product into the eastern markets, and the consequence was that for years not very much money was made by the orchardists of California.

What was the result? We know that the farmers combined in the most extensive and powerful organization ever made by farmers until they controlled transportation facilities of the railroads then along the western coast. This was effective, but dangerous.

I have a friend living in a little country town. He uses a good deal of oil and some gasoline. He used to burn oil in his house, but he does not now. There is a railroad and a station within ten rods of his house. He cannot ship a barrel of oil over that road, or a barrel of gasoline. He is served by a man from a depot nine miles away, delivery being made over country roads and sometimes they are as bad as they are along some parts of this State. (Laughter.)

You can realize how angry those people become, with a railroad at their very door, while they cannot get over that transportation line the commodity they need.

My point is this, that the great corporation controlling the sale of gasoline and oil is not attending to its business when it makes it impossible for these people to be served. They are trying to serve a big territory by teams in an altogether inadequate way.

This is another illustration showing how we need to understand each other and each other's needs. Many people do not realize how necessary oil is to the farmer; or is it that they do not care?

I could quote many other illustrations of this kind, showing that this "no man's land" which, like the instances given, is neither agriculture nor railroading, but which is crossed by many businesses and many interests, is the territory where we need to work together.

It is rather fashionable to blame the farmer for the high cost of living and to assume that if he were the equal of the European farmer we should equal the wheat yield of England, Germany and Denmark.

In the first place, let me show how it is that England produces twice as much wheat as we do. For fifty years we sold our cattle and our grain to England for the labor it took to produce it. In this way the fertility of their land is maintained out of our supply. It was over twenty years ago that Sir Henry Gilbert said to me: "So long as you Americans will give us your cattle for the cost of herding, and sell us your corn for what it costs to cultivate and raise it, we will get along nicely, but when you learn to feed your corn to your cattle on your own land, then God have pity on the English farmer."

So much for fertility, by which we see that America could not imitate the methods of England because the supply does not exist to fertilize our acres as we have fertilized theirs.

Again climate is often the deciding factor in yields. The hot sun and bright light that make this pre-eminently a corn country effectually prevent a maximum wheat yield. Wheat needs cool weather and shady days while ripening. If we had these we would not lead all other countries in corn yields. So I might mention many other factors not under the farmer's control, and not known to our critics, yet they powerfully influence yield.

In America the question has not been "how much per acre," but "how much per man," because land has been cheap and labor high.

It is a good principle that the shoemaker should stick to his last. The farmers cannot tell the railroads how to do their business and the railroad man cannot tell the farmers how to do theirs. Each must study his own profession, but they should confer freely when they meet and cross.

For examples, the railroads sometimes put hardships upon the farmers. Jones goes out to get a better bull. He has a hard time to find one, but when he does he tries to ship it. Now, it is a little calf that weighs 300 pounds, but when it goes on the shipping bill it appears as a bull and weighs 4,000 pounds. In other words, the railroads have penalized the bull business. They could afford to ship the bull for nothing. Jim Hill never did so good a thing as when he shipped bulls for nothing.

I speak of these things only to illustrate that we should get together frankly in such meetings as this and talk about the territory where we overlap and where we come together. It is all a tremendous game of serving the public, and we cannot serve the public as we ought, until we understand each other better. The only way to understand the needs of one another is to get together like this, and find out where we are failing to make the most of the service we are trying to render to the public.

I think that my ten minutes are up. I thank you. (Applause.)

President Abbott.—The annual consumption of lumber in the United States is three and a half times the annual production. The price of lumber has increased three fold in the past fifteen years. As farmers and builders we were admonished that we must look elsewhere for building material. An increased use of cement is assured, not only for farm buildings, but also for road construction, and the era of permanent road building is upon us. I am not sure but what one solution of the road building problem will be for the cement people to go into the road building business themselves, where the contract runs into the millions of dollars and building roads on a wholesale scale at a small profit, or at least furnish cement at a small margin.

Another solution of the road question which is being agitated, considering the great amount of work to be done, is for the State to go into the cement business.

I now take great pleasure in introducing Mr. Edward M. Hagar, President of the Universal Portland Cement Company, whose topic is, "Possibilities of Cement on the Farm."

POSSIBILITIES OF CONCRETE ON THE FARM

EDWARD M. HAGAR, President, Universal Portland Cement Company,
Chicago, Illinois

MR. CHAIRMAN AND GENTLEMEN: My friend, Mr. Meeker, robbed me of the only joke I knew, because he thought I was going to precede him, or rather that he was going to precede me, and he also took part of my subject away by saying what he thought a silo was.

I want to make it plain that I only speak for the information bureau of the company, and I am going to be very brief.

We have felt for a great many years that all that was needed to bring about practically the unlimited consumption of portland cement on the farm was education, and how and where the best to be used and in a great many ways had been endeavoring and never further than that, I don't mean any particular brand—but simply the right use and the prevention if possible of the wrong use, or the use in the wrong way, because it does more injury than a good many right uses benefit the industry, and among other methods. We have been trying to work together with Farmers' Institutes, and especially in our home State of Illinois. We believe the Farmers' Institute stands for the very thing this country needs more than anything else. I don't mean only in the matter of cement and in the matter of agriculture, but it stands for education, co-operation and efficiency.

I cannot believe for a minute that the world loses, or anybody loses by greater efficiency in anything. I cannot believe for a minute that if you double a crop of any particular kind anywhere in the world it is a loss, for what you save to the world will be saved to the producer. There is no such thing as too great an efficiency. It may appear that the greater production may reduce the profit, but the profit is always greater, because the increased production is always at the expense of equivalent cost.

Believing in that way I have tried to subordinate, and we have subordinated our own identity in such ways, and our educational bureau not only never mentions ourselves but never mentions our brands, and we have lecturers on the subject of concrete construction, who never mention in any way the source of their employment.

We only ask that we be permitted to know what the farmer has done, what one farmer has done successfully and then tell the other farmers what has been done. If the merit of the material of portland cement is not there no amount of that sort of propaganda idea or knowledge is going to produce any lasting results. We find it, however, to be so successful that all we need to do is to tell, especially the farmer rather than any other class, how

it can be used carefully, simply and properly, the ways in which it can be used on the farm by farm labor except in extreme cases of too large structures, and the use goes on.

There are over six millions of farmers in the United States. The portland cement in this country or the production of concrete has increased to eighty-three millions in 1912, yet you will see that fifteen barrels a year on the farm will take every bit of the cement production in the United States. It will not take much work to use fifteen barrels of cement on each farm. The silo is something to which we have devoted a great deal of attention. Our book on the silo is an exhaustive work on the subject, and it is often referred to by the United States Government, yet we find in this country that the farm is not as productive because the silos are not used the way they should be used.

Mr. Meeker says, it is only lately that we find any use for silos in steer raising. It has been used on the dairy farm. There are many different ways in which it can be used, but I am not going into those details. But the broad matter is what I have most at heart, and that is in all those directions we believe we are not only producing a greater demand for our product but we are doing the world good. We are tending to diminish the cost of living.

There is one direction in which I feel sure the manufacturers of portland cement are doing a great deal of good, and that is in showing the desirability of hard, permanent roads connecting cities, towns and the country with the farms. Wayne County, for instance, is the ideal spot of the world. It has eighty miles of concrete roadway. I don't think there is any other hard, permanent roadway that compares with concrete, and certainly concrete is a hard, permanent road, and I am speaking of hard permanent roads. If some better road can be built, well and good, but so far, I don't think of any.

The effect of the cost of living on the value of farm products and on the efficiency of the farm of a hard, permanent roadway, when you can run over it any day of the year with a small number of horses for a heavy load, and can take a heavy truck and go as fast as you should go, is tremendous, and from a speed standpoint, it is a wonderful piece of work that can be done, and I might add here that it does not cost anything.

I have a good many figures worked out to show that in every case the increase in the value of the property that fronts on the road is greater than the entire value of the road, the entire cost of the road. There are naturally two fronts on a road, so right away there is less than half of the cost of the road applied to either side, yet the value of the property on either side, is increased greater than the cost of the road in front. This point has been made so much of, the increase of the population of cities as compared with country districts would be corrected by that more than by any other means, and more than in any other way. It has been so corrected. For instance, the figures show that in the district around Detroit, the country towns, the farming district that is fed by these concrete roadways, some of which are twenty-three miles long—of course in Detroit that takes you quite well in the country, much more than in Chicago—for the first time the population in the outlying districts is increasing faster than in the city. Not only that, these hard, permanent roadways are going to reduce the cost to the consumer of food products, and the farmer is going to get higher prices for the reason that the difference in the cost of transportation will not entirely show in the delivery value.

The difference of the transportation cost is something tremendous. It is well known that a great deal of the farm products of all kinds that is carried to the railroad station costs more to get it to the railroad station than it does to get it from Illinois to Boston or New York, because you take five horses to do what you can do with two horses on a hard, level, permanent, smooth roadway. That is done every day. You can go over to Detroit and see it for yourselves. You can see the farmer coming up with five horses until he strikes the concrete road when he takes three back and goes on

with two. You will find there are more one-horse rigs in Wayne County than in any other place in this country, because one horse can haul all that a wagon will carry.

Those are tremendous facts, tremendous in their effect. I believe if the farmer would work on the subject of hard, permanent roads, it is the greatest thing he can work on.

It is not expensive, as I have explained. In fact, it is much cheaper than any other form of permanent roadway, and then you get the increase in value and the increase in the efficiency of transportation both ways, and the time of transportation, which is valuable. You know, of course, this last year and every year, for various reasons, farm products are allowed to rot on the ground for the single reason that they cannot be transported away.

I don't think I could speak on any subject that would mean more to the country and the gentlemen here present than that one matter. People are always waiting for somebody else to do something, always waiting for somebody else to come along and build their road. We have developed this country by railroads, and we have been content to rely on them. I tell you, gentlemen, it is a mistake, a serious mistake. I saw countries abroad, of course they didn't have the railroads, and they are not so dependent upon them as we are—they have splendid roads, although these roads now have automobile traffic, in England and France—they used to consider them to be perfectly satisfactory roads—they have to do something to get harder roads than they had.

When this country has hard, permanent roads from one part of the country to the other, you will have a different country, you will have a different cost of living, and you will have a different value in your lands, and you will have a great deal more efficiency. You will have the advantage of the city brought closer to the country. You will have all the advantages of greater education and pleasures, and all that man desires, if you can annihilate distances and bring the transportation of your food products so close that the transportation is not one of the largest items, if not the largest item, in their ultimate cost. I thank you. (Applause).

President Abbott.—The greatest material question on this earth is that of food production, beside which all other questions, however, great, take a secondary place. Then, too, the seat of empire always rests where the soil is fertile and the people are well nourished. The decadent nations along the Mediterranean tell of an impoverished soil, and they now are but the echo of their former grandeur.

The Illinois Farmers' Institute stands for systems of agriculture, which are both profitable and permanent, with the expectation that the seat of Empire will permanently abide in Illinois.

Director F. I. Mann, of Gilman, farms 500 acres of land and is perhaps the best example of a scientific grain farmer in the State. He has adopted a system of farming whereby his land grows richer from year to year, although he makes a practice of selling his grain.

I now introduce Mr. Mann, whose part on the program is to define the "Illinois Idea of Soil Fertility."

THE ILLINOIS PLAN FOR PERMANENT AGRICULTURE

MR. FRANK I. MANN

MR. CHAIRMAN AND GENTLEMEN: A good thought expressed by Lincoln was that a nation need not fear for the future when the fundamental facts relating to the old art of farming have been well understood; in the future, the fundamental facts of what may be called scientific agriculture must be

come common knowledge, if this nation does not need to have fear for the future. The art of agriculture has been exhausted of its ability to meet increasing population with increased food production, and the better the art is applied the more rapidly does the source of the food supply become impoverished; but the science of agriculture has the power to increase food production to a maximum extent, and with methods which may be indefinitely continued.

PROMPTED BY HIGH MOTIVES •

The highest motive of the Illinois Farmers' Institute is to extend this scientific information until it has become common knowledge. We believe that any method of stimulating a soil for increased production at a sacrifice of its future production is a crime, and should be treated as such. We welcome the efforts of all forces prompted by the desire to extend true scientific agricultural information with a motive to establish permanent agriculture, and with all such forces the Illinois Farmers' Institute will heartily co-operate.

For the first time in history, there is a conception of permanent agriculture with high production, and much of it has been revealed by science through the efforts of the Illinois Experiment Station. This permanent system, which is being called the Illinois system, is based on the following fundamental scientific facts:

SECURING MAXIMUM PRODUCTION

That something cannot be made from nothing; that food products, as all material things, are composed of chemical elements with some of these elements derived from the air, some from water and some from the soil; that when all these elements exist in sufficient amounts and in natural forms, the great processes of nature's laboratory provide for their use by growing plants, and a maximum production is realized; that the food elements derived from air and water are normally greatly in excess of needs; that of the elements derived from the soil some are likely to be deficient for maximum plant growth; that all growth diminishes the supply of some of these; that on normal soils the only elements usually deficient are calcium, as limestone, phosphorus as phosphates, and nitrogen as organic matter; that when these are supplied in sufficient quantities, maximum plant growth may be secured, and as long as an adequate supply is maintained a maximum harvest may be realized; that as long as nitrogen is maintained in the form of organic matter the activities which result from its decomposition will render available the mineral elements existing in the soil, in inert forms, or that may be applied to the soil; that to maintain nitrogen is an ever-continuous proposition, because it is used in such large quantities and because of the unstable character of the forms in which it must be used; that the economic source of nitrogen is the clover or other legume crop which has the power of securing free nitrogen of the air; that simply growing clover or other legumes may not add any nitrogen to the soil but it is only when the crop itself is added to the soil, either direct or as the manure of animals, that the nitrogen content of soils will be increased; that calcium, as limestone, must be supplied, primarily as food for plants, especially as food for clover, and when supplied sufficiently for this purpose, other functions of limestone will also be realized; that the decomposition of the organic matter necessary to maintain nitrogen will liberate from natural forms the elements, potassium and phosphorus.

These three things are all that need to be supplied to any normal soil to provide for maximum production.

With these facts in mind we can arrange systems of farming to meet the requirements of immediate soil conditions. Of primary importance is the clover or legume crop, which must be grown often enough in rotation to provide sufficient nitrogen for the grain crops to be grown in the rotation;

and all rotations should be arranged around the legume crop with this idea.

How to apply this system to any given farm depends somewhat on the local conditions. If the soil still contains limestone so that clover will grow reasonably well, it may be necessary to supply only phosphorus, for a time, which is to be turned under with clover as food for the grain crops which are to follow. If it is an old and well drained soil, where limestone is well leached out, and clover will not grow with certainty, it will be necessary to supply both limestone and phosphates as food for clover, that clover may be grown. As legumes may secure nitrogen from the air, it is necessary to supply them with only the mineral elements; and furthermore, the legumes have the power of feeding on inert mineral substances without the ordinary processes of liberation.

When the value of this trinity—limestone, phosphate and clover—becomes common knowledge and is applied to agriculture, then will we see high production on a basis that may be indefinitely continued—more permanent than the everlasting hills, because it can make a fertile soil after the hills wear out.

President Abbott.—The Illinois Farmers' Institute is thoroughly in harmony with the doctrine of soil fertility as expounded by Mr. Mann; it is their tenet of faith, the Apostles' Creed. The condition of a man who would go to a Methodist camp meeting and attempt to preach anti-Christ, or the condition of a man who would go into Mike O'Leary's saloon on St. Patrick's Day and cry "To hell with the Pope," would be tolerable compared to the condition of a man who would presume to preach the general use of a complete fertilizer at a farmers' institute in Illinois.

The American Steel & Wire Company has put out some valuable booklets on agricultural subjects. In one of their orthodox publications they are in accord with the Illinois idea of Soil Fertility, which is at variance with the interests of the Fertilizer Trust.

One of the bi-products of the American Steel & Wire Company is ammonium sulphate; their natural and best market is with the fertilizer people. It has been reported that when the A. S. & W. Co., put out its handbook on soil fertility they were threatened with reprisals by the threatened loss of their best customer for ammonium sulphate unless they recanted and called in their heretical booklet on soil fertility. It is reported that the retort courteous from the wire people was in effect that the fertilizer people could go hang, that they were more interested in the continued prosperity of the farmers to whom they sold millions of dollars worth, or more, annually than they were in the fertilizer people to whom they sold but thousands of dollars of product.

Mr. Frank Baackes is the vice president of the American Steel & Wire Company, and dictates its agricultural policies. By reason of the valued service he has rendered to agriculture, at a critical time and on a most important subject, he is accorded the seat of honor tonight, and he will now address us on "The Policy of the American Steel & Wire Company With Reference to the Improvement of Agricultural Methods."

THE POLICY OF THE AMERICAN STEEL AND WIRE COMPANY WITH REFERENCE TO IMPROVEMENT OF AGRICULTURAL METHODS

MR. FRANK BAACKES, Vice-President of the American Steel & Wire Company, Chicago, Illinois

MR. CHAIRMAN AND GENTLEMEN: The subject assigned to me, "The Policy of the American Steel & Wire Company with Reference to Improve-

ment of Agricultural Methods" is a very natural one to put to me on the part of the Illinois Farmers' Institute. Especially is this true in view of the great activity we have displayed in this direction, and we are only too glad to have this opportunity to explain our position.

More than one hundred years ago the wise political economists of France enunciated the principle that commerce and finance, in order to be successful, required the firm foundation of agriculture. This principle has long been recognized in Europe but has only lately been recognized in this country.

In the late seventies (1878) the movement of the experiment stations and the agricultural colleges was introduced into this country, and men were awakened to a clearer and better thought of agriculture. These institutions have worked wonders in many directions but they cannot do it all alone.

When leaders in business saw the population increasing and the yields of staple grains decreasing, each per acre, they saw that something had to be done immediately to remedy this evil. The business man is peculiar in that with him to see the necessity for doing means to do it.

The American Steel and Wire Company has intimate contracts with the farmers of this country through a live mailing list with two million eight hundred thousand farmers. We sell these farmers, through distributing agencies, a great many of our commodities, and there is not a farm nor a household for that matter, that does not use our commodities in some form. In fact, wire is one of the most indispensable agencies of modern civilization. In its most humble form, the nail, it holds together the boxes in which the products of a thousand industries are carried to the consumer, and it is a prime necessity in the erection of building in which we live and work and engage in recreation.

In another form, wire fences the farms of the world, and this is indispensable in the production of our food. In another humble form, the coiled spring—it is a necessary feature of three-fourths of our machinery.

In the form of rope it hoists the products of our mines. In another shape it makes electrical appliances possible and extends into the finest details of a watch, the strings of pianos and the operating mechanism of pipe organs.

A thousand commercial and industrial uses might be named in which wire could not be replaced by any other known agency.

And as we found by the actual facts that the farmer was by far the largest consumer of our different commodities, we were naturally very much interested in him and his work. And I wish to say that our motives to help him to be prosperous and successful are not based upon any philanthropic principles—far from it (laughter), because the American farmer does not want philanthropy, but are based purely upon commercial principles and modern constructive salesmanship—the building up of our customers, to increase their wants in order to supply them.

The nation's buying capacity, as well as the farmers, is in direct proportion to the net cash income. And the American farmers' income is now measured by yields per acre of 14.1 bushels of wheat, 25.8 bushels of corn, 91.4 bushels of potatoes, and so on.

Germany, the land of great efficiency, has shown that the average yields of these crops can be 28.9 bushels of wheat, 200 bushels of potatoes.

It is to the interest of everyone in this country that the highest possible yield of food stuffs be produced per acre. Our culture has advanced and we demand the good tasting things today and we cannot go back to the old ways and we will not go back.

The thirteenth census shows that we have increased 20 per cent in population and have decreased 8.7 per cent in live stock production which is one of the important means of feeding this increased population.

Low yields per acre, decrease in live stock, lessen the buying capacity of the nation and halts culture.

I speak of culture not in the narrow meaning usually given the word, but I mean by culture that efficiency which enabled the artisan to make the

best meerschaum pipe with the fewest cuts; that enables the woodman to produce the highest possible finished piece from the majestic Norway pine with the fewest strikes of the axe; that enables the farmer to produce the highest yield per acre with the least possible physical labor.

In order to see this efficiency carried on in every walk of life the people must be able to buy the modern appliances so necessary to give us comfort and ease. And we can only have all of these if we have prosperous and productive agricultural conditions in this country. There is no trouble in recruiting our industrial wants of men from the rural districts at any time, because the industrial working conditions are constantly improved upon and the physical labor constantly is reduced by labor saving appliances.

Why, therefore, should not any concern which is able to, endeavor to lighten the burdens of the farmer and endeavor to make that calling attractive to the average man by giving him all the light possible on the subject of effective farming?

And as we realized that the farmer was our best customer, we started our propaganda to show him how to do his work more efficiently and easier, how he can live better, raise more live stock and grow more grain. For this purpose we created a Department of Agriculture which is headed by men who learned in Europe, as well as in America, how to grow more grain and raise more and better live stock on the farm. What we are giving the American farmer is nothing new. It is but the gathering of the data of the old country and the best that has been done in this country, and compiled in brief form to meet the conditions of this country. And what literature we are sending out in printed booklets and posters and other forms is all carefully passed upon by the highest authorities in this country in different agricultural colleges.

These agricultural colleges are only too glad to have us spread this propaganda which they would most willingly do, if their means would allow them to.

We also want to say that in sending out this printed matter free of cost to every farmer, we have no intention of interfering with the business of the publishers of this country. We are willing to and will gladly co-operate with any institution or enterprise or association to help create in the farmer a greater liking for his calling and thereby create better conditions on the farm, more production, more happiness and contentment for everyone—make and keep the farmer prosperous and happy and it will reach every other class in our country.

Personally, and from a company standpoint, we must do our part to raise our country to the highest level of culture. And recognizing that the principle that sound agricultural conditions make the foundation of prosperity and success, it will be the policy of the American Steel and Wire Company to do all it can for the improvement of these conditions. (Applause). I thank you. (Applause).

President Abbott.—It would be difficult to conceive of businesses more closely related to each other than that of the packer and the stock grower. Usually farmers are very conservative in their business operations, but as cattle feeders they become arrant gamblers; they may buy their cattle right, feed them right and then strike a fluctuating market that will take away all profits. If there was more nearly the stability in the cattle market that there is in the grain market, it would lend encouragement to the cattle business. The cattle men all look for a bargain counter feeder deal on a rotten market, but in the end such conditions are not good for the industry.

According to the teaching of the College of Agriculture it is no longer necessary to keep live stock to maintain the fertility of the soil. If grain

farming is the more satisfactory, then that is the system of farming that will be followed.

The whole cattle business is on a readjustment basis at this time and we will be pleased to hear from Mr. Meeker, who will speak to us on "The Diminishing Supply of Live Stock and the Remedy."

THE DIMINISHING SUPPLY OF LIVE STOCK AND THE REMEDY

ARTHUR MEEKER, General Manager, Armour and Company, Chicago, Illinois

MR. CHAIRMAN AND GENTLEMEN: I have enjoyed this evening. It has been very interesting and very illuminating to me. I don't know why I was asked to speak. I never made a speech before and I have never answered to a toast. I don't know whether I was asked here because I am one of the trustees of the State University, or because I am a Lake County Dairyman, or because I am a poor packer (laughter), but apparently the latter is the reason.

I think it would have been more interesting if Professor Mumford could have added my subject on to his and told something that was really worth listening to. I really wanted to come tonight without making a speech, but I wanted to come so badly that I could not give up the pleasure of coming, so I am going to inflict myself upon you for a few moments.

I met Mr. Hagar Saturday afternoon and I told him of my predicament, and asked him what he thought I better talk about. He said, "If I were you I would talk about a minute." (Laughter.) He also suggested we might change subjects and that I should talk of the use of concrete on the farm and he would tell us about the beef supply.

He knows I know something about the use of concrete on the farm. I had various outbuildings and silos on my farm. I had wooden buildings. I did not know much about concrete, but I did know a lot about Mr. Hagar and as a matter of friendship tried his cement, expecting the silos to crack and the buildings to fall down. Much to my surprise they did not. They are the most satisfactory buildings that I have ever had to do with in my experience.

I think, perhaps, one subject I might treat of in the limited time allotted is what is going to happen to us under the Democratic administration, with free beef. It seems a very live topic. Every time I meet a man interested in cattle he wants to know what I think of the future prices of beef and what bearing the importing of beef from foreign countries will have upon the prices here? I think half a dozen cars of beef came in the other day from Montreal. That was a little surplus of dairy cows, and in cleaning up the season they were shipped down to New York.

It was largely advertised in the papers, and the query then went up in the press—why were we not getting cheaper beef, that beef was coming in from Canada? Six cars of beef represent about three minutes trade in greater New York, that is, that much is sold every three minutes, so those cars didn't have a very wide bearing on the trade of New York, or on the selling price of beef in New York.

Some beef is coming into this country from Australia. However, Australia is so remote, and the business there you might say in its infancy, that we will never hear much from that country. It is so remote that it must come frozen, no refrigeration, and this country does not take kindly to frozen beef. Probably most of the beef that does come here from Australia, some is headed this way and some has arrived, will be used in the way of canned meat and trimmings for sausage, but very little carcass beef will come from there.

I presume when affairs get settled in Mexico, which seems to be a great breeding ground, that all of the feeders and ranchman of this country will

be able, as time goes by, to get some cattle from that country. They apparently have large resources in the way of land, and I look to Mexico as a great breeding ground in the future, and a country which will supply the corn belt cattle at less than the prices given by Professor Mumford of what we have to pay today. I think that will be a boom to us all interested in this business.

The only country in the world today that can supply beef to this country in any quantity, and is doing it, is the Argentine Republic. Probably many of you are familiar with that country as I am. When the duty was first removed quite a little Argentine beef came from England on the trans-Atlantic liners to the New York Port, and some to Boston. It made a pretty good market, the first shipment, and sold fairly well. What came in last week was not in the best condition and made a very poor market, being thanksgiving week, and it had a bad market. A steamer arrived in New York today, twenty-six days out from Buenos Aires, with some cattle aboard, refrigerating cattle. That is the first direct shipment of any size that has come to this country, and that will meet probably a fair market.

As far as I know of now, we will have limited shipments from the Argentine Republic to this country on account of the steamship space. The Parana River is a very shallow and very wide river and of necessity only light draught boats can go up the river. There are a few light draught boats there already, but the refrigerator space on the sea-going boats is limited, so that the regular lines of boats running between there and England at the present time have little more space than can be used and permit of their English service in the boats.

The next month, commencing the first of January, there are coming to this country, I think, the total is about 6,600 cattle, the total capacity of the two boats. So we may probably look forward to that much beef arriving on the Atlantic seaboard, probably New York, after a 26 or 28 days' journey. The beef is from eight to ten days old when shipped, because the refrigerators—the cattle having to be loaded on and off the lighters and shipped out to the river, have not a large capacity, and the beef has to be accumulated for shipment, and therefore, the beef will be from 26 to 42 days old when it reaches New York. The chances are they will have to sell it in that immediate vicinity. I don't imagine that any of it will be shipped more than a hundred or a hundred and fifty miles away from the seaboard.

I have been wondering, perhaps, whether other steamship lines would be built so as to increase the carrying capacity between that country and this, but I suppose there is no guarantee that this administration or its policies will be perpetuated at the end of four years, and I don't know what these steamers, if built for that trade, would do at that time if they could not carry beef to this country. I assume that is a matter of whether we have a full dinner pail or not four years hence. If the present plans of the present administration work out satisfactorily to the greatest number of people, we will continue to have free trade.

I hardly know why I was asked to talk on the subject of what can be done with the diminished beef supply unless it is on the theory that most people that talk about subjects and who have a "cure-all" for all ills know the least about the subjects of anybody that could talk. So it is with very deep apology to all you learned men who have made a study upon this subject that I say anything.

I don't think I quite agree with Dean Davenport. It seems to me if we could have large corn crops, in the first place, if we could have more intensive farming, do it more intelligently and get a larger yield per acre, we would be better served. If a man instead of having a thousand bushels of corn on a given amount of land will have fifteen hundred bushels, he will be as well off if it were selling at fifty-five cents as if he had a thousand bushels of corn and it was selling at seventy-five cents a bushel, and in that way beef could be produced cheaper. I think the energy of everybody ought to be in the direction of raising the most per acre that this country is capable of. I am not certain that fertilization is just the best plan to

pursue. I think all plans are good. I do think this, though, and I am quite positive of it, that all the corn belt people in this farming country and the United States in general would be better off if more live stock were raised. (Applause.)

I don't know why every farmer who feeds cattle thinks that he has to buy the feeders of somebody else. I think it is quite possible they could raise more cattle to a good advantage. We all know there are approximately ten million calves slaughtered as calves in this country every single year.

A large portion of them are a highly specialized dairy breed—I have in mind the Jerseys and the Guernseys. I doubt very much if it would pay to raise these calves into beef feeding cattle and eventually into beef. But my theory is that a great many calves are slaughtered, say from good Holstein cows and good sized red cows, that could be raised profitably to the raiser.

I don't think anybody can figure exactly, on a farm with a few calves, just how much it costs to raise them. You can figure it out with paper and pencil but there is always more or less feed waste if you feed up live stock on the farm. I think it will be almost the salvation of this country to preserve our calves or those of them that are worth raising. I have no accurate data on that subject, however.

The average dairyman that raises calves wants to sell them because he wants to sell the milk. On my farm I raise three hundred calves a year, and none of them get any milk after they are three days old, and I doubt if anyone of you can tell the difference between one of the milk fed calves at the age of one week, one month or one year. I think we have a lot to learn about the feed and the feeding of cattle in this country. It seems to me a very small proportion of the knowledge that has been gained, demonstrated and proved past all peradventure in all of our state universities is taken advantage of by the farming community at large.

I know it seems to me there is the greatest need in this matter, that more information should be gotten out and disseminated and as I understand, this institute is very largely given to that purpose and I think the work is splendid.

I don't know if anyone quite appreciates the condition the packer is in. If anyone in the world is between the devil and the deep blue sea it is the packer. The raisers of cattle seem to feel that the packer has a brief to buy each individual lot of cattle they feed, whether originally bought well or bought badly, or fed well or fed badly; at a profit. No one that I ever heard discuss the subject seems to care what we do with them or what we get from them after we buy them. It is very easy to sit up and buy cattle at prices satisfactory to the people who produce them, but it is quite another proposition to sell beef at prices to get you out whole.

I don't know whether all you gentlemen appreciate what the fresh meat business is like. I think you will all bear me out in the fact that not one week of any one month or year are cattle left over. They are always cleaned up somehow and by somebody. We don't keep them. We don't average to keep them but three days in our refrigerators, and they don't average four days in the east. What we buy this week we must ship next week and what we buy next week we must sell the week after. There isn't cold storage capacity in this country for holding over twelve days' supply in the coolers of the refrigerator companies and the branch houses.

It takes about that long to handle the cattle, ship them east and dispose of them, perhaps keep them a few days to oblige the butcher who delivers them. If we get light receipts on Monday, the cattle market is universally and uniformly higher. Now, the commission man is just as wise as we are. He knows about how many cattle the trade wants. You never hear about those markets—you only hear about the time when the meat is dear. When the branch houses are full, and cars held back at icing stations because beef cannot be sold, and our coolers are full, and the stock yards are full of cattle, and cattle a little lower, we hear a great deal about that.

But there is another side to it that you gentlemen don't see. I have secured facts and figures. I don't know that they will be particularly

interesting, but they are rather interesting to me as showing how much more we have paid for cattle in the last few years. They were taken from our records in a hurry this afternoon and I think they might be rather interesting. They don't refer, however, only to high class steers, but they refer to all grades, and all kinds of cattle, including cows, wolves, chunks, fat steers, grass steers and everything. Between 1909 and 1911 there was an advance of twelve dollars per head; between 1911 and 1912 there was an advance of twelve dollars per head; between 1912 and 1913, there was an advance of ten dollars per head.

In the four years—the four years from 1908 to 1913, there was an advance of thirty dollars per head. In the present year, I think some cattle have been bought that would not bring any more than 11 cents a pound, and that would mean the beef, in fact, would have to be sold at something like 15 or 16 cents a pound in the east, while today our average selling price last week, for instance in Boston, was under 12 cents, and they take nothing but the best beef shipped to any city in the whole of the United States.

I might say that in the fresh beef business, we have no one selling price. I have never yet given an order to any branch house manager that he must get a certain price, because conditions are such that we cannot get a straight give and take price. We start in on Monday to get as much as we can for our beef, and we try to clean up every Friday night. Often-times we make money in the first part of the week, just about keep even during the middle of the week, and are losing money the rest of the week. It is fair to say that about 25 per cent of the time our beef is sold at an actual loss, and probably fifty per cent of the time during the year it is sold at a price that gets our money back, and about 25 per cent of the time, or one week in four, we make money.

An extra large run of fish on the sea coast any one week will hurt our trade. Rain on Saturday will hurt our trade, because we don't clean up, and we have to get rid of the cars that are coming on the following Monday. Now, heavy receipts of vegetables or fruit can be held over, but it is different with fresh beef, because when the beef is shipped it has to be sold; it cannot be held.

One other little point—perhaps I have taken a little more time than I should have—but there is one other little point that I don't suppose any of you gentlemen know about, that is quite an added expense to our business which some time will be eliminated. We paid last week \$1,274,000 for cattle and hogs which we thought were sound and healthy but which were condemned upon post mortem by the government inspectors and tanked. That was our loss. Nobody really was at fault there. The cattle looked sound. Most of them had tuberculosis and most of the hogs had cholera, and they were condemned. That, of course, is quite an added expense in doing business, something which we don't see how we are going to get around. We hope some day these diseases will be stamped out, or the losses placed where they ought to be.

A very small percentage of our population, of course, are interested in getting good prices for cattle in this country, and the other 86 or 90 million are interested in getting beef cheap. They see no reason why beef should not be sold for eight cents a pound, and they have it all figured out, especially through their favorite organs, the newspapers, where we are making the difference between what beef ought to sell at and what it does sell at.

I honestly think the average man thinks that we make anywhere—I often see them figure it out in the papers that we make thirty-seven dollars a head on cattle that we buy and sell, whereas, as a matter of fact, we have not averaged in three years to make one dollar net, and for a considerable period have done business at an actual loss.

I might say for the benefit of the congressman who it seems does not know that there are six firms engaged in the Argentine Republic, two American and four English and Argentine firms. The same allotment of space has been made to each of the firms in the boats coming to this country that has been in effect on the boats going to England. So that every

firm in the Argentine Republic that wants to can try their luck in shipping beef to this country. There is one thing that I have not said anything about, and that is in all the new trans-Atlantic liners they have refrigerating space, that is, the liners between here and England.

Ten years ago we filled them with beef from this country going to England. At the present time, a difference of only ten years, we now have beef coming from England to this country in the same space. That is the case of where the Argentine beef has gone to England and met a poor market there and then it is transported to this country.

Of course, there is any quantity of that space, and considerable of that beef will come in trans-shipped from England, but the rate is high, and there is some danger in that market—some danger of the beef not being in good condition, so it is a somewhat hazardous trade. However, we will get more beef in that way.

I don't know of anything else I can now say. If you want to ask me any questions, I will be glad to answer them. (Applause.)

President Abbott.—I am sure that all enjoyed Mr. Meeker's presentation of these questions from a packer's standpoint.

The subject assigned to Mr. C. V. Gregory, Editor of the *Prairie Farmer*, is "Improvement in Efficiency and Design Through Co-operation Between the Manufacturer of Farm Machinery and the User." I now present to you Mr. C. V. Gregory.

IMPROVEMENT IN EFFICIENCY AND DESIGN THROUGH CO-OPERATION BETWEEN THE MANUFACTURER OF FARM MACHINERY AND THE USER

C. V. GREGORY, Editor *Prairie Farmer*, Chicago, Illinois

MR. CHAIRMAN AND GENTLEMEN: We hear a great deal about the large yields per acre that some European countries are able to get, how much more they can get than the farmers in this country, but we don't hear so much about the efficiency of the American farmer in getting larger yields than the European farmer. One American farmer can produce as much corn as five or six European farmers, and one principal reason why he is able to do this is because he has much more efficient machinery to do it with.

The term "intensive farming" is very often misunderstood. A great many people today think that intensive farming or intensive cultivation means getting a man out with a hoe in his hand and digging around in the ground. If we can get one-half of the people who are in the cities to go back to the soil, we would have intensive farming and intensive cultivation in this country, but the fact of the matter is that one man on forty acres with a gang plow and pulverizer can do much more intensive cultivation than three men on one acre with a hoe and rake can do.

Intensive cultivation is a matter of working the soil well. Men cannot do that by human labor, especially in this country, and if we had to depend on human labor for this, as the foreign countries do, to a quite large extent, the food products would be much higher than they are now; in fact their prices would be almost prohibitive.

The only thing that is keeping the food prices in the United States within the reach of all the average man, in a country like this where labor is scarce, especially for agricultural purposes, is the fact we have had in this country manufacturers of farm machinery who have provided us with the most efficient machinery in the world, and we have had farmers, intelligent enough to take this machinery and get the most good out of it. It is this

combination that has enabled one American farmer to be worth as much as half a dozen European farmers. The fact that he has, up to the present time, required large acreage to do this is not so important a fact as we are inclined to believe. As necessity demands and prices justify he will reduce that acreage. It is a fact the process of development of farm machinery in this country to its present efficient stage, has been quite largely due to the co-operation of the manufacturer of farming machinery and the farmer. One concrete instance of this that has come to my attention is the effect of the Wheatland plowing match, now one of the classical agricultural institutions of Northern Illinois, on the development of plows. When I was out to Wheatland this fall, I found one make of plow was pre-eminent there. Upon inquiry I learned that the manufacturer of this plow had had representatives there at every plowing match for probably the last thirty years. He had studied plowing, had talked with the plowman, and by co-operation with those men had devised a type of plow that would do the work most efficiently. He was not the only manufacturer that was there, but he was the only manufacturer who followed that matter most successfully.

The same is true of other types of machinery. At the present time our older forms of machinery are pretty well standardized. Even at that a good many of them are far from being perfect, as most of our farmers who have wrestled with them out in the field can testify. A good many times when we get out in the field with a machine that has probably stood under the trees longer than good for it, we find to our sorrow that adjustments that are two or three years old are not made as readily in the field as in the repair shop or as they seem to be made on the exhibit floor of the State Fair.

We feel a good many times that we might, perhaps, if we had the manufacturer of that machine there, at a certain time give him some valuable information as to some changes he might make in his machine. They are just little things, but some of those little things are the things that make a man warm under the collar. A good many times after the farmer has gone through some of these little troubles he does not have the most cordial feeling towards the manufacturer of the farm machinery. A good many times a bolt goes down instead of up, and working in that position is not most advantageous to it, and we go and get the burr off or there is a little piece broken out and we take out the bolt or the nut and make some adjustment, and when we get through with it we put the bolt up the other way with the burr on top, maybe it don't look quite as nice, but it is more handy, and we go on with our work wondering why the manufacturer didn't put the bolt on that way in his factory. At another time we wonder why in the world the manufacturer did not put a square head on that bolt. When we finally get it out, if we do get it out, we will put the head of that bolt on the wheel and pound it a few times until we have that head square instead of round and we find out we have improved the efficiency of that machine greatly in doing it.

Those are very little things that we find in most of the standard forms of machines, and almost every farmer could give the manufacturer of farm machines a few ideas how those machines could be improved.

The makers of the most successful farming machines in this country are the ones who have given their machines most thorough trial on the farm under actual farming conditions. That does not mean on the farms of the agricultural colleges necessarily, but it means on the farms of some ordinary, or perhaps some farmer who has not even ordinary intelligence. When that man has gone out and sees what he can do with the machine, he finds flaws in it he can give the manufacturer perhaps some ideas which would never have occurred to his machinery experts.

The greatest need, perhaps, at the present time, is the co-operation between the manufacturer of farm machinery and the farmer in the development of machinery. The old machinery is pretty well standardized, and is as a rule fairly efficient. We are coming to the era, however, of new machinery, and in entering into the era of new machinery, we will strike new problems, and in meeting those problems the manufacturer will have to develop types of machinery that in a good many ways are a great deal

different than the types we have at the present time. If in entering this field he will co-operate as closely as possible with the farmer who is to use that machinery, I believe the machinery can be made up a good deal more efficient, and that a good many causes for friction will be removed, and a good deal more cordial feeling established between the farmer and the manufacturer of farm machinery.

One of the greatest lines of development along farm machinery lines within the next year, I am satisfied, is the development of power machinery on the farm, especially power machinery for use in the field, and for that reason I am especially glad to note that the man we have with us as the representative of the agricultural machinery interests is a man who has specialized in the development of power machinery.

We have discussed at quite a little length this evening the feed problem that confronts us in this country. It is a problem that will require a good deal of discussion before it is finally solved. One of the greatest elements in the manufacturing of feed on the farms in this country is the fact, under present conditions, we are compelled to use so large a quantity of the feed produced on the farms in the production of that feed, that is, we find it necessary to use altogether too large a percentage of the feed we produce to feed the horses to furnish power to produce the feed.

In the early days in Iowa it used to be necessary for the farmer to transport his corn by wagon to a Mississippi River shipping point. The distance back from the river that a man could establish a farm was governed by the length of the haul to the river. So, when starting out with a load of corn to go to the river he would have to have enough feed in the wagon to feed his team and still have a little left when he reached the river. You can readily see that when he got back a certain distance or a certain point from the river it would take all the corn that he had on the wagon to feed his team, and there would be none left to sell by the time he got to the river. We are not quite that bad, though, in feeding our horses on the farm. We can feed our horses and still have a fair amount of feed, enough to sell, but if we could take the feed that goes to feed the horses in this country, and feed it to beef cattle or dairy cattle, or feed it to the hogs, our present meat shortage would be very largely eliminated.

It costs anywhere from \$75 to a \$125 a year to feed a farm team. Most farmers don't realize how much it does cost, because it can't be kept track of, but when they do stop and figure it out, most of them are astonished by the amount of feed that goes into the farm feed in the course of a year with no production whatever except power, that might be produced much more economically by kerosene, gasoline or by electricity, or a number of other forms.

It is a source of trouble and a problem still far from being solved, adapting mechanical power to a farm in operation, but that is a question I am satisfied our farm machinery manufacturers will solve in the near future.

Last fall at the State Fair I was astonished at the number of small farm tractors exhibited, though we have had for a number of years large tractors, most too large to be used on the ordinary corn belt farm. Some men have told us that we would have to adapt our farms to the large tractors, that small farm tractors could not be built. We must overrule those suggestions, if we can consider them as suggestions, that we could only use large tractors. I believe the manufacturer will solve the problem of putting in tractors adaptable to small farms. In solving this problem, however, he will have to co-operate with the farmer.

Just one instance that came to my attention not long ago. A company in Ohio started out last spring to put out a gasoline cultivator. They put this on the market without sufficient trial and spent a great many thousands of dollars in advertising it. Their office was overwhelmed with inquiries, thousands and thousands of inquiries, asking for prices and catalogues on their gasoline cultivator. They sent out, I think, about a thousand machines. After a short trial most of them came back. The company found after all their expensive advertising, and after their expensive start in manufactur-

ing, that there was some radical faults in the design of that cultivator. There were a number of mistakes in its construction. The company is now engaged in reorganizing its business, and it is rebuilding its plant, and is completely changing the design of this cultivator.

I believe ultimately they will put out a successful cultivator, but they could have saved a great many thousands of dollars and a great many heart-aches, doubtless, on the part of the managers, by first putting out their cultivator in a limited way and letting the farmers try it and finding out whether or not it was adaptable to the needs of the American farmer.

The same thing is going to be true of every power machine as it is made and developed. The manufacturer must co-operate with the farmer in finding out the kind of machines that he wants, the kind of machines that he will buy, and the kind of machine that will do the work efficiently, so that the farmer will be justified in selling his horses and putting in machines, and using his feed for other purposes; he must co-operate with the farmer and let the farmer experiment with the machine, and in that way put out the kind of machine that fills the market acceptably. I believe it will be done, gentlemen, but I believe it will be done quickly and efficiently only through co-operation with the farmers.

Just one other point I want to speak of, and that is the fact the farm machinery manufacturers in the past, in some cases, have not been as quick as we think they might have been in developing machinery to meet the new needs of the farmer.

I think that is probably as much the fault of the farmer as the manufacturer. We haven't made our needs known to them and one reason was we felt we had not the opportunity. Maybe we can make our wants known to the manufacturers. They can find a way to get in touch with us to find out what the latest results of agriculture are and what machinery is required to meet those developments.

One thing I wish to refer to more particularly and that is Mr. Mann's talk on the Illinois plan, the plan for permanent agriculture. It requires supposedly a large amount of limestone in the soil. So far the farmers who have been following that system have found that the only firms where they could get the machines to spread the limestone was to go to the blacksmith and make them. Now, it is hard for a blacksmith to understand what they want, and it is hard for the farmers to explain to the blacksmith. But the farmer who knows what he wants shows his blacksmith how to make an up-to-date and most efficient machine, and that is the one that is used most extensively for spreading these products. Now that is one of the things where the manufacturer, I feel, is a little behind the times.

There is one other invention we ought to have, and that is some sort of an attachment to the threshing machine that will handle the clover properly. You cannot thresh it successfully in the ordinary threshing machine, for the reason that the clover comes out with the hulls on. We need right on that point an attachment that will handle the sweet clover and thresh it and hull it at one operation.

Those are a few little things we need, and a few of the ways that occur to me in which the farmers and the manufacturers can co-operate with each other to mutual advantage. I thank you, gentlemen. (Applause.)

President Abbott.—If any interest is closer to the farmer than the packer it is the manufacturer of farm machinery, with this difference, one buys from the farmer, the other sells to the farmer. When wireless telephones are perfected it will at least be a source of entertainment for the maker of a new style of a machine to maintain connection with the user of his machine in the field. He will be able to hear many vigorous, man-sized, red blooded soliloquies, with much merited criticism as to the machine under discussion; its maker and even the pedigree of his ancestors will not escape attention. Some concerns request public suggestions as to better-

ments. Should the manufacturers of farm machinery adopt such a policy, one way to co-operate with the farmers will be made easy. I take pleasure in introducing Mr. J. B. Bartholomew, President of the Avery Manufacturing Company, who will talk to us on "Maintaining Friendly Relations Between the Manufacturer of Farm Machinery and the User."

MAINTAINING FRIENDLY RELATIONS BETWEEN THE MANUFACTURER OF FARM MACHINERY AND THE USER

J. B. BARTHOLOMEW, President, Avery Manufacturing Company, Peoria,
Illinois

MR. CHAIRMAN AND GENTLEMEN: I realize this is the most excellent opportunity for me to make a speech but that is entirely out of my line. It is a hard proposition for me. This subject got scrambled in its delivery to me. I don't know that it made any difference to me. Before I start in I want to say if my friend Gregory over here would read the farm paper ads he would know by this time after reading some of the other publications that the Avery Company makes threshing machines with attachments that will hull not only clover but alfalfa and sweet clover, and everything else, and they have been sold by the hundreds—I might say by the thousands, on approval. If they don't do the work they send them back. So, if any of you are interested in that proposition come to me and I will show you the way out.

This subject worried me a good deal when I started in with it. I could not see but what the farmer is doing all he can do to co-operate with the manufacturer. He is buying everything the manufacturer can make and paying for it. So far the the manufacturer co-operating with the farmer, I think it is up to the farmer to tell us what he wants us to do, and if we can't give him what he wants or as good as he wants, we should pass on to the next fellow. I could save you a lot of time by reading this, although I could talk a long while and not say much. As Old Sam Jones said, he would rather have a seven-shooter pulled on him than a seventeen page manuscript, and I am going to try to get through in ten minutes.

"Ways in which the farmer and the farm machinery manufacturer might co-operate to mutual advantage."

When Mr. James J. Hill brought out his famous suggestion "back to the land" and which offered as a solution to the great problem of supplying the food products to future generations of a rapidly increasing population in the cities, while the increase in the farming population was comparatively much less in proportion, it was thought by some that his suggestion came from a selfish motive and was intended to encourage people from the cities to settle along the railroads in which he was interested, to raise crops for the railroad to haul.

But to analyze his suggestion, we have to conclude that it originated with him long before it came into print; he had long since come to understand the rapidly increasing demand for farm products, he had discovered the vast, fertile prairies northwest of Minneapolis, as yet unoccupied, and could see that railroads were necessary to make these lands available, and with this understanding of the situation he built the railroads, but simultaneously many other railroads had been established through the great west and south and therefore his suggestion applied just the same to other territory and we must conclude that his suggestion had in mind a new system which was to be adopted, and which may be termed a sort of co-operation between the railroads, the consumer and the producer. Every fellow fighting for his share but all combined laboring to the common end, build up a great productive and commercial people.

About 25 to 30 years ago the packers started to introduce a new system of dressing and distributing meats. Packing houses were estab-

lished not only in Chicago but in Kansas City, Omaha, Sioux City, and Fort Worth, and other central points.

The plan was to establish these packing houses in the centers where live stock was largely raised to save as much as possible the long haul shipments of live stock; to introduce new methods in the slaughter houses that work a saving in labor and make it possible to utilize the by-products which had formerly gone to waste. But oh! what a howl went up from the local butcher. He insisted it was a scheme intended to put him out of business. He protested, and in some localities a desperate fight was put on, but the new system was adopted. It was adopted because it was the best system of handling the meat products of the entire country. There may have been strife and there may be at this time strife, but it is a great system and those in it have been co-operating towards the building up of a system of packing and distributing the meat products of the greatest country on the face of the globe, which is big enough to take care of its own people and a good part of the rest of the world.

Shortly after the war, or rather say in the year, 1875, the development of farm machinery as a manufacturing and commercial proposition had commenced to take on an air of stability. Prior to that it was more or less experimental. True enough, the plow and a few other farm implements had been to some extent established, but since that date the introduction of new machinery and improvements has gone like prairie fire until now the farmer can be supplied with a machine to do almost any kind of work on the farm and the great system of farming by machinery has been established and the United States has become recognized as the greatest producer not only of farm products but of farm machinery that makes possible these products at a low cost, with a high rate of wage. And it is this co-operation between the manufacturer who produces the farm machinery and the farmer who buys it and uses it that makes possible for Pillsbury's flour to find a market in London, and caused the world to recognize the United States as the leader in the production of farm machinery.

The farmer is talked to a good deal and talked about no less, and sometimes criticised by the fellow who could not live without him. I heard a prominent lawyer say less than three years ago that he was afraid the country was going to the bow-wows because the farmers were buying so many automobiles. He argued in the first place they could not afford them, in the second place, if they can afford them they cannot afford the up-keep and tire expense, and even if they can afford these, they haven't the time to run them.

I have heard bankers say that the automobile was a poor investment for the farmer. Some years previous similar remarks were heard with reference to the purchase of farm machinery, and most every hardheaded business man would condemn a farmer for buying a threshing machine outfit and predict his financial ruin within two years. That is the way it goes.

But, after all, the farmer has gone on quietly attending pretty much to his own business, doing just what he thought was the best thing for him to do and he has bought the farm machinery and the automobile and everything else that he wanted and applied it to his use in an economical and profitable manner, and a new system of rural transportation has been established and will end in the establishment of good roads, and make farming the most profitable, the most interesting and the most healthful of all occupations.

Up until recent years the design and construction of farm machinery had been along the lines of reducing farm labor.

Tractor farming—This is a new system of farming that is gradually being introduced and established and it means greater possibilities. It means economy and is therefore necessary.

I am not here to take the matter up in detail. I may be accused of making the suggestion from a selfish motive but I would prefer to co-operate in the establishment of some great economic system for the good of future generations, than to spend my time touring Europe and clipping coupons, even if I had them to clip.

Mr. Frank I. Mann has, through years of study and experience, accumulated a fund of knowledge regarding the soil and its conditions. He has published a book which lays out a system of soil treatment that will establish permanent fertility, and Professor Hopkins and others have been working along similar lines. It is apparent they recognized years ago the necessity of conserving and building up the fertility of the land and the fact that the farmer could not go on year after year taking crops from his land without putting something back, and that to do so was not farming but mining. Mr. Mann says the art of agriculture is old, but the science of agriculture has come to include mathematics, chemistry, physics, biology and I think he should have added mechanics.

I believe in almost everything their soil experts have published, and yet I have gone far enough with experiments and investigations to prove that most land plowed somewhat deeper than usual, enough at least to get below the plow pan, will pay and also using a certain kind of plow with a new type of sub-soiler that will cut about one-half the width of the top plow furrow and from two inches to four inches deeper, turning the sub-soil over in the bottom of the furrow and not bringing it to the top, will pay big for the farmer who does it. Furthermore, the importance of plowing at the right time is a suggestion that cannot be profitably overlooked.

Here in Illinois and out in Iowa we have a horse raising country and in such sections the question of power for the farm to do all these things at the right time does not strike us so vividly, but, nevertheless, power for the farm is soon coming to be a problem and the tractor is the solution. But it must be light enough in weight and powerful enough at the draw bar to do the work and not pack the soil.

Raise all the horses you can for profit, use them all you will, but in a few years the horse famine will be on. It would have been here three or five years ago except for the coming of the automobile at the rate of from two to three hundred thousand a year and in spite of that the price of horses has kept going up. I mean good horses, brood mares (others don't pay) not old plugs, that will eat their heads off every thirty days. The day has gone by when a fellow with an old plug of a team and an old plow and an old cow and an old sow can be classed as a farmer. (Applause.)

Before I sit down, I am not getting this advantage again, I want to speak with reference to what Mr. Gregory mentioned with regard to the manufacturer keeping in close touch, or as he said, co-operation, with the farmer in regard to putting on bolts right side up and so forth, and making them with round heads or square heads. There is no doubt there are changes of improvement along that line, but Mr. Gregory should understand that the bolts as a rule are not made by the implement manufacturer but by manufacturers who makes a business of making bolts, and the only part the manufacturer plays in the matter is to see these are put in right end to. That is the biggest part about the factory of farming implements, just to see the bolts are right side to, in the right length and put on right end to.

I don't know how many thousand bolts I have handled in the year, and I have no doubt sometimes they do get them wrong end to. I don't believe, however, the farmer is so very much interested in that, because if he happens to find one wrong end to, and I don't think he would ask the manufacturer to send an expert four or five hundred miles to turn that bolt right end to before he would buy the machine. That is one great thing about the American farmer. We send out our so-called experts and there are farmer boys, there are fellows who come in off the farm and spend a few weeks or a month in the factory and they will get out and produce better results and set up all sorts of machinery than the fellow who has been raised in the city or raised in the factory a college man, or the chap fed with books until he is blind, but I don't know why it is the farmer boy in this country is the safest on the whole proposition. You cannot

put a piece of machinery on the farm so complicated but what that boy will know all about it before he starts to use it. Gentlemen, I thank you. (Applause.)

President Abbott.—One of the greatest problems on the farm is that of transportation. In this respect the farmer is absolutely dependent on the railways; they can make or ruin cities; they can foster and encourage agriculture along their right of way, or they can do the reverse. It is manifestly to their interest to co-operate in every practical way and get the good will of the people along their lines. This I believe is the general desire of the present management of railroads. Unfortunately their predecessors bequeathed to them a suspicious and unresponsive public, with a keen memory of a certain classic and historic phrase as to the rights of the public.

The successful marketing of farm crops, of produce, fruits and vegetables can never be accomplished without railroad co-operation. Perhaps it may require an independent operating company, with a monopoly, if you please, of the business along a system, which will justify the building of cold storage houses and the perfecting of an efficient organization. This will not only give to the farmers a ready and profitable market for produce, perishable fruits and vegetables, which are not wasted but it will assist the dwellers of the city to solve the cost of living question as well as furnish business for the railroads.

We frequently have pumpkins to waste in the country, but who ever heard of a surplus of pumpkin pies in the city?

Some railway men have taken an active interest in the agricultural development along their lines, and it gives me great pleasure to introduce to you, tonight, one of these men; Mr. A. C. Johnson, passenger traffic manager, Chicago & North Western Railway Co., will speak to us on "The Interest of Railroads in Improved Agricultural Conditions."

THE INTEREST OF RAILROADS IN IMPROVED AGRICULTURAL CONDITIONS

A. C. JOHNSON, Passenger Traffic Manager, Chicago & North Western Railway Co., Chicago, Illinois

MR. PRESIDENT AND GENTLEMEN: I wish to express the pleasure of having the opportunity of meeting you gentlemen this evening and being entertained with the discussion by the technical and wise gentlemen of their professions, who have stated the relations between these large industries and the farming pursuits of the country.

I am, however, reminded at the outset that I am a substitute here for another gentleman, the Vice-President of the Rock Island Road, who was unexpectedly taken ill at the last moment. I think he was perhaps advised that I was to substitute for him and it made him sick. I don't think his recovery would have depended upon hearing me to the end, on account of my condition. I am just recovering from a very bad cold and am almost unable to be heard, yet I was so much interested, here, that on my return to the city at eleven o'clock this morning and finding my invitation to be present, that I could not resist the invitation to be with you.

I am reminded, of course, that the prosperity of any transportation company, such as we represent, extending through nine strictly agricultural states, depends entirely upon the prosperity of the farming pursuits in those agricultural states. We are most intensely interested in the surplus produced in those states, because it is in the surplus, of course, in which we

participate as a tonnage movement. Home consumption means much to you, but it is the surplus that means much to us. The C. & N. W. Ry., has tried to co-operate for the past ten years in every consistent manner possible to stimulate the advantages that have been offered by the State Agricultural Colleges and Farmers' Institute Boards in all the different states who have followed in consistent lines such as advocated by Dean Davenport here tonight, and such procedure I am glad to state meets with his approval.

We have the opportunity of attending a great many meetings to help the farmers, most of them "Back to the Land Movements." One of them, I think, was written up very effectually by Mr. Keelet of the Tribune, in which he took considerable interest.

We attended several days ago one of these "Back to the Land Movements," consisting of practically all the governors and of the immigration agents of these states with the governors acting as a body, and asking the aid of the transportation companies. They got up a set of by-laws longer and more complete than the Constitution of the United States, and then after several days they came to the most important proposition, namely, the financial support of the institution.

Miss Grace Abbott, a very fine lady of this city, who presides over the destinies of foreign immigration departments, was present as a spectator, and was very much interested, because she thought it tended to assist and help immigrants in general. She was asked to contribute something in the way of a few remarks, and arose and stated that "she came there simply for information but was certain from what she had heard in speeches and remarks made, that there is not a governor or an immigration officer or inspector present who lives on a farm, or ever intends to. It seems you are just advising other people to go back to the land, but you don't ever intend to go back yourselves. She stated further that she had resided in the country but preferred to live in the city and she assumed the others intended doing so themselves and that it was their purpose only to induce others to go back to the farm."

However, they continued their efforts towards raising the money and believe they are still doing so, at least I know they were last week. There are several organizations of that kind, and they afford actual competition among themselves in their endeavor to assist a project of which they have no practical knowledge. In striking contrast are the efforts of this worthy organization.

I met your President, Mr. Abbott, several months ago and am pleased at having the opportunity of telling you what the C. & N. W. Ry. Co., is doing and what we have tried to cover in the last ten years, and in doing so we simply are adopting the same line of procedure as other roads, along different lines perhaps, but all tending towards the same result.

We work in these nine different states entirely under the State Agricultural Colleges, or under the jurisdiction of the state authorities. During the past sixty days we have carried special trains through the states of Nebraska, South Dakota, two special trains in Iowa, one in Minnesota and one in Wisconsin, including a special dairy train, a special grain train and an alfalfa special. These special trains are operated under the auspices of the Ames College of Iowa, the Minnesota Agricultural College and the Wisconsin and South Dakota Agricultural Colleges.

The itineraries were all prepared by the state authorities or the State Agricultural Colleges by a directing force, something like this body over which Mr. Abbott presides. We effectually reach every town of any importance on the Chicago and North Western Railroad, where we are asked to have these lectures delivered. The advertising that is done—there is more or less of it—is arranged for by the Chicago and North Western Railway, and not in a single instance, to my knowledge, in ten years, have we had other than the most strong and loyal support from the local press and the institute forces in charge of the work.

We have followed some of these matters up afterwards to see how they turned out, and I want to say that the good will established by reason of the active and loyal efforts of the local press throughout the state we operate in,

is worth considerable to us, and the combined co-operative efforts have been beneficial alike to all interests.

We have many other departments on our line that require more attention than this department. We have no learned or technical agricultural expert at the head of this work which is conducted along practical business lines. This matter is all taken care of as a business proposition under one department, and we could only succeed in the way we have, in securing results we have, through the efforts of these bodies like the one presided over by Mr. Abbott here tonight.

Now, some of our active departments are operation and safety, in which the public, including the farmer, is as much interested as the transportation companies themselves. By reason of our efforts along the lines stated the different departments of our roads have had a fund of assistance, and one of the prominent problems receiving attention today by transportation companies is safety, which movement originated with the C. & N. W. Ry. The department is presided over by a man peculiarly adapted for this work, who has spent his life in this class of work and maintains an organization that is most effective. The public is only now beginning to appreciate the importance of this work.

In one of the southwestern states last winter an over-zealous member of the legislature introduced a bill which required that two trains operating on a single track coming in opposite directions, should, within a few feet of each other come to a full stop, and that neither proceed until the other had passed by. This was intended to promote safety.

We have no grievances or troubles with the farmers' organizations on our line which we do not go and listen to personally; if it happens that we have no representative there. It is our aim and desire to come in as close touch with the patrons of our road as we possibly can, having full knowledge that it is impossible to do business in an enemies country.

I do not know that I can say anything more to you tonight in my condition, and am sorry that I should have been inflicted upon you even for a short time. I thank you. (Applause.)

President Abbott.—Some agricultural problems are chronic and always with us; some are acute. One of the most violently acute agricultural problems at the present is the production of beef.

Professor Mumford has been a student of this subject for years, not only from the standpoint of the corn belt cattlemen, but he has seen and studied range conditions, the Canadian Northwest, England and continental Europe and the Argentine, and is well equipped to discuss problems of beef production. He will now talk to us.

PROBELMS IN BEEF PRODUCTION

PROF. HERBERT W. MUMFORD. Head of Animal Husbandry Department
University of Illinois, Urbana, Illinois

MR. CHAIRMAN AND GENTLEMEN: I think for the first time in the history of this country, the cattle men have come to realize that they are face to face with the fact that all the factors entering into the cost of the production of beef have been rapidly increasing, much more rapidly in fact than the price of fat cattle. Cattle men have reluctantly curtailed their cattle feeding operations until, as you all know, at the present time there is a distinct shortage of beef in this country.

I am not asked to discuss the question of how to remedy the difficulty, but simply to discuss the problems of beef production, and if I am able to

carry through the thought I have in mind, I will attempt to discuss only one of the many problems of beef production, because I believe around that problem others may be grouped.

The time was when the corn belt cattle raiser had available, in feed lots and feeding cattle, at the cost, or based upon free range, plus transportation charges to the corn belt. The time was when the price of fat cattle was based very largely upon that cost of feeding cattle plus a very low cost of feed used for fattening. From those conditions, as I said in the opening statement, the cattle men of this country have come to face the fact that every factor which enters into the cost of producing beef has increased to a very great extent. A brief consideration of a few factors will illustrate the point I have in mind.

I have not gone back very far, and I don't want to go over all the history of cattle raising in this country, but simply to bring out the fact that even in the last thirteen years the conditions which have surrounded the cattle raising industry in this country have changed very rapidly and very significantly.

For the sake of brevity I must confine what I have to say to corn belt conditions. The two largest factors in the cost of cattle, looking at the subject from the standpoint of the cattle feeder, are the feeding cattle and the feed used in fattening.

In 1900 the conditions surrounding the cattle feeding industry were approximately as follows:

Choice 1,000 pound feeding cattle could be purchased at \$5.50 per hundred weight. The feed for finishing, with corn at 36 cents per bushel, would cost \$27.42, or a total cost of \$32.42 for the steer. Prime 1,400 pound steers were worth \$7.25 per hundred weight on the market. The value of the steer plus the pork produced from the droppings, would amount to \$105, leaving a net profit on each steer to the cattle feeder of \$22.58, a very attractive profit.

In 1910, the same feeding steer that cost \$5.50 ten years earlier would cost \$7.25 per hundred weight, or a 1,000 pound steer would cost \$72.50. Corn and other feeds used in fattening had increased correspondingly, the average value of corn for the year being about 50 cents per bushel, thus making the total cost of finishing the steer to a weight of 1,400 pounds \$38.28. This would make the total cost of the steer \$110.78. The market price of prime steers had also increased so that it would be fair to assume that prime cattle brought \$8.50 on the market, or for this 1,400 pound steer, \$128.40. This would leave a net profit of \$17.62 over cost of production.

Conditions had changed still more radically by 1913, when choice 1,000 pound feeding cattle cost \$7.75 per hundred weight, or \$77.50 for a 1,000 pound steer. Corn was worth 65 cents per bushel and roughage was correspondingly high, so that the cost of finishing a steer from 1,000 to 1,400 pounds weight was \$51, making the total cost of the steer \$128.50. It will be agreed that \$9.00 per hundred weight was a good price for prime steers during that year, making the value of the prime steer in this instance \$131.60, or \$3.10 above the cost of production. Thus, it will be seen that since 1900, when a very attractive profit could be made, the conditions had changed to such an extent that by 1913 such a small margin of profit was left that many would not be safe in undertaking the business.

It might be well to supplement the facts given by a statement concerning the average value of farm lands in the United States for 1900 and 1910. They were, according to the thirteenth census, \$15.57 in 1900 and \$32.40 in 1910. Lands are now still higher than they were in 1910. During the same period the cost of labor increased from \$26 per month in 1900 to \$35 in 1910 and \$38 in 1913. These are all significant facts in relation to the cost of beef.

I wish to make another reference to the fact that beef production is, after all, competitive business. It is competitive business from two standpoints. It is obliged to compete on the farm with other animal producing industries like pork production, dairy and sheep husbandry; and it is competitive in another sense in that the products which are used in producing beef are in demand in the market for other purposes than for making beef.

We must not for a moment imagine that beef production is an absolute essential in farm management. It is not. It can be dispensed with. I have no idea it will be dispensed with, and we certainly don't want it to be. We must, in referring to beef production as a competitive industry, meet fairly the proposition that it is an expensive product.

Beef is an expensive product to produce. It must always be an expensive product. There is no getting away from it. There is no subterfuge about it. We must face it. Compare, for instance, the efficiency of the pig and the steer. Taking averages into consideration, the pig will produce 10½ pounds of pork from a bushel of corn. The steer will produce 6.7 pounds of beef from a bushel of corn. Compare those two products on the market today. The pig product from a bushel of corn is worth 85 cents. The beef product on the market today, taking the seven pounds that is the limit for a bushel of corn, is worth 63 cents, scarcely the price of a bushel of corn.

Another factor which the beef producer faces is the matter of time which is involved. There are some things that cannot be done, and one of those things is that you cannot make a two years old steer in a minute. It takes a long time. Suppose we all believe and agree it is a good thing to go into the cattle raising business, and that the present prices warrant it. It will take, the best we can do with a steer or a cow, about three years before we can put the two year steer on the market. To be sure, we can put it on as a yearling, and everything tends in that direction, but at that it will take two years.

And what a difference there is when you come to compare the dairy cow, who can produce just as soon as you put her in the stable. Of course, it takes more labor, but still when you take into consideration that there are some dairy cows which produce a thousand pounds of butter a year, and the fact that we have no very marked difference in the producing efficiency of beef cattle that has ever been discovered, we have very little hope for producing cattle with greatly increased efficiency. So we must take into consideration the time that is involved in this matter.

I see my time is up. I want to make just one more observation, and that is, it seems to me that one of the great problems that confronts the beef producers of this country is that while beef is high it is necessarily high, and it is bound to be high. We might just as well understand that beef will be higher or else we will have no beef. Then we may say the public will not stand for it, will not pay any more for it. Very well, I believe they will. I believe that the consuming public, the buying public, don't understand the cost of beef. I think that the vast majority of our population have no conception of the cost of a pound of beef to the producer.

They think because cattle are higher in the market the producer must be getting rich. That is one thing it seems to me the producer must do, he must educate the consuming public up to a full realization of the cost of a pound of beef, or a ton of beef, or any particular unit you wish to work on. Cattle men understand perfectly well, while farmers generally, I believe, perfectly well understand that at the present time beef production is the least profitable animal enterprise on the farm. (Applause.)

President Abbott.—It has been very popular for the past few years to make junketing pilgrimages to Europe to study rural credit systems. This feature, if not over worked, has been stretched near to the limit. The need of the present time is not so much a study of European systems as a study and an analysis of Illinois agricultural conditions.

Director A. P. Grout, of Winchester, a banker-farmer or a farmer-banker, has given this subject of "Agricultural Credits" considerable thought and will now talk to us on "Agricultural Credits from the Farmer's Standpoint."

AGRICULTURAL CREDITS FROM THE FARMER'S STANDPOINT

A. P. GROUT, Winchester, Illinois

MR. CHAIRMAN AND GENTLEMEN: I came near not finding this place tonight, and for that reason I apologize for not being here on time. I suppose the embarrassment of being in a large city and in a fine hotel like this led to the mistake. As I came up I saw there was a meeting here in this large dining hall to my left and I walked in and I was met by Mr. W. G. Eden. He met me very cordially and escorted me to my seat. As I was going to my seat I felt sure I saw our president here, Mr. Abbott, sitting at the speaker's table in the center, ready to preside, so I was not much concerned about Mr. Eden meeting me and acting as floor master and master of ceremony. Of course those that know Mr. Eden know that he is built that way and he can't help it. After I was sitting at the table I looked at the program and I began looking it over and I found that it related entirely to good roads. Then I looked around and I saw Mr. Abbott again, but it was not Mr. Abbott. Now, I don't know who the gentleman was, but I thought he closely resembled Mr. Abbott. If I should ever meet him and see him I shall apologize.

You will note, by this program, it is down to the farmer and the banker. I don't know just why this combination was originated.

I remember reading of an incident where a deacon was attending some church meeting in a town. It was a beautiful little place and he was much interested, and he was walking around, he had plenty of time, and finally he strolled into the cemetery, and looking around he noticed a large monument there—I think the largest in the place—and he went up and read the inscription on it, which was "A Lawyer and an Honest Man." He was much interested and he walked around and read the inscription several times, and finally a gentleman seeing him came up and asked him if he had found the grave of an old friend. He said no, but that he was wondering why the two fellows were buried in the same place.

Now, I have no personal acquaintance with the banker who is to follow me, so what I say here is not personal in any way. A great deal has been said of late in regard to agricultural credits, and I am sure I don't know why, I don't understand why. I don't understand why there has been such an agitation and why a commission consisting of two men from every state in the Union has been sent over to Europe to study this subject. I am quite sure from what I have read—I haven't been in the old country myself—that the conditions there are very different from the conditions in this country. I am sure the farmers of Illinois don't want to be compared with the farmers of the old country, or the rural people, and I don't understand why it is that it should be thought necessary to look after the credit of the farmers of Illinois.

Now then, we are proud to claim, as a class of people here, that we are the most prosperous of any in the State of Illinois, and naturally the farmers in the State of Illinois will not change places with the laboring people in this State, the manufacturing people, the merchants or any other class, and why it should be deemed necessary for the government to send a commission to the old country to investigate this subject and come back here and recommend something that will give more credit to the farmers of Illinois, I can't possibly understand. Now, it does not occur to me that any legislation can change the situation here in any way.

Now, some of the plans, as I learn, in the old country are something like this: If it was found necessary to extend credit or to find easy money for the people in the country, the farmers go together and form an organization and they mortgage their lands for the benefit of those who are so unfortunate as to need to borrow money.

Now, they may do that in the old country, and it may work out satisfactorily, but if you find any number of farmers in Illinois who would be willing to mortgage their farms and have their wives sign those mortgages with them for the purpose of securing money to loan to some of their neigh-

bors, it will be when their bump of philanthropy has been very much enlarged from what it is now. That is judging from my knowledge of the farmers of this State. It may be you will find men who will do it, but I doubt it very much. There is nothing to hinder them from doing it now, without any legislation, so far as I know.

The other plan proposed is that the government loan the money on long time at a low rate of interest. But have the farmers of Illinois reached the point where they are willing to accept assistance of that kind? Even if the money of all the people could be taken and loaned to a class of people—any class—I am sure the farmers of Illinois will not be the first ones to ask any such favor or any such privilege. Now, I believe the farmers are able to go it alone.

I remember years ago when I was in the academy in Vermont it was the custom there on the opening of school for the committee who were looking after the school and those who were interested to visit the school, and there was one attorney in our town who always made a speech on those occasions, and I think he made the same speech every time, possibly not, I am not sure about that, but I know I heard it several times, and he told the story of the ape who had two little ones, but for some reason the mother ape took a fancy to one and a dislike to the other one, so that every time there was any danger it would grab up the favorite offspring and go up a tree and run on a limb out of the way of danger, and the other one was compelled to escape the best it could, to look out for itself, but the time came when the old mother ape was not there and some ferocious animal came along and ate up the favorite offspring and the one who had been taught, or had, from experience, been compelled to look out for himself, easily escaped. Of course the lesson which he intended to impress upon the students at that time was that we should learn to rely upon ourselves, to do things for ourselves, and when the time came we would be prepared whenever necessity arose, and we could take care of ourselves.

Now, it seems to me it is much the same with the farmers in Illinois. If the government is going to look after their finances and provide them with the means to obtain easy money, it seems to me that the great incentive which the farmer has now will be taken away from him. It does not occur to me that the farmers of Illinois need any assistance in the way of securing easy money.

My impression is the thing this country needs most is information, and information will lead them to better farming, and lead them to practice permanent and systematic farming here in Illinois. That is what they need rather than assistance from the government.

We have down in our section quite a demand for money from the farmers, almost more than the bankers feel they can provide. The reason of it is on account of drought and short crops, and the farmers in order to keep their stock are compelled to borrow money, or they feel they must have money. If they had profited by some examples they have had there for the last twenty years they would not be in the condition they are in today, if they had grown alfalfa as they could have done they would have feed, the reason being that the alfalfa goes down to where it will obtain moisture, and there were good crops of alfalfa wherever they had them.

Another thing is the absence of silos. If the silos were there and the farmers could have used their corn crops, such as they had, for fodder, there would have been no occasion for borrowing money with which to carry their stock during the winter.

So it is their own fault, it seems to me, when lessons of this kind are brought home to them, and it is worth a good deal more to those farmers than it would be by the government or any body of men to step in and advance them this money.

I believe the farmers of our State should become reliant, self-reliant and dependent upon their own exertions, their own efforts, and I am sure as a class we have not reached the point when we are willing to acknowledge that we are in greater straits and more in need of this assistance than any other class of people in Illinois. Gentlemen, I thank you. (Applause.)

President Abbott.—Farm lands in Illinois are overcapitalized; by that I mean that farm lands are so high in price that it is difficult for them to be made to pay the common rate of interest on their face value.

It takes considerable money to buy a farm in Illinois, and it is a great undertaking for a young man to buy a farm and pay for it with but little capital to start with. The tendency of the times is for farm lands to come under the control of men of wealth, rather than into the control of ambitious young men whose principal capital consists of their ability to perform many days' hard work. The result is a rapidly increasing tenant population, good neither for the land, the tenant or the nation. A most important movement is the attempt to work out land credit systems that will relieve this situation. There are many reasons why farm lands are much sought for. They are safe investments, then too the farmers are accumulating a little money, and in looking for an investment they put their money in the only kind of a security with which they are acquainted, farm lands, and there is getting to be much competition. They will invest their savings in a rubber plantation in Mexico, a cypress swamp in Florida, in an impractical irrigation scheme or in wheat lands 1,000 miles northwest of Winnipeg, or even in the real estate of a gold mine before they will invest in the stocks and bonds of an utility that serves them every day.

There is no good reason why the securities of an utility should not be as staple as the price of the farm lands in the territory which it serves and be as highly prized; and much better it would be for a corporation to have its securities generally held by the people who patronize it.

Why is this condition as it is? There has been so much wild cat, corporate financeering in the past that farmers are wisely suspicious of this class of investment. The addition of millions to the capital stock of a corporation, by a resolution of the board of directors, without adding one cent to its physical valuation, is not an action calculated to inspire confidence to the timid investor. In the years gone by, corporate management sowed to the wind and their successors reap the whirlwind. Recent disclosures indicate that the wind sowing process is not a lost art. The farmers had rather buy irrigated lands than stock needing evaporation.

Mr. E. D. Hulbert, vice-president, Merchants Loan & Trust Company, is the next speaker and his subject is "Agricultural Credits From the Banker's Standpoint."

AGRICULTURAL CREDITS FROM THE BANKER'S STANDPOINT

E. D. HULBERT, Vice-President, Merchants Loan & Trust Company,
Chicago, Illinois

MR. CHAIRMAN AND GENTLEMEN: I came to this meeting tonight with a good many misgivings, as I was laboring under the delusion that the farmers of Illinois were complaining in some way about credits they were getting from bankers, and thought the government ought to come to their assistance, but I heaved a great sigh of relief when I heard what Mr. Grout had to say. As he says, it has not been my good fortune to meet him before, but I think if we ever meet again we can sit at peace at the same table or even sleep together.

I feel as though I ought to be qualified to talk upon this subject, whether I am or not. I was born and brought up on a farm, and about twenty years of my banking experience has been in country banks, so-called, dealing with farmers largely and with agricultural credits, and for the last eighteen years I have been working for a bank in Chicago which makes a specialty of farm loans. In the last few years we have loaned over eighteen millions of dollars on farm lands located in Illinois and Iowa.

After this experience extending over pretty nearly forty years I am prepared to say there is no class of people in the United States which is receiving credits from banks more freely or on any more favorable terms than the owners of farm lands.

There are in the United States now over twenty-five thousand banks, and about two-thirds of those banks are so-called country banks who deal largely with the farmer, and who depend upon the good will of the farmer for their patronage and their profits. These banks hold nearly one-half of all deposits in the United States, and the anxiety of those banks to obtain the good will of the farmer is marked, at times carrying them beyond the bounds of good banking. Only a few days ago I talked with a banker from South Dakota who came down here to borrow money to keep his reserve good, and he said that his little bank was carrying one hundred thousand dollars of loans made to farmers for the purpose of buying automobiles. Another banker who was in my office a few days ago from Iowa said that in his county alone the banks were carrying four hundred thousand dollars of that kind of paper. So it would seem that credit is being extended pretty freely to farmers in those localities.

I believe it would be no exaggeration to say that no one else today engaged in industrial pursuits can borrow money on long time at as low a rate as the owner of farm lands can. They are borrowing cheaper than the railroads can, or any other great industrial interests represented here tonight.

As Mr. Hagar stated, there are over 6,300,000 farms in the United States, according to the last census, and 62 per cent of these farms are operated by the owners, of that 62 per cent, two-thirds are free from any mortgage and the other third are mortgaged to about 27 per cent of their value, and the others are occupied and worked by tenants.

We have no statistics regarding the rented farms, but it is fair to presume that the people owning farm lands and renting them are not suffering from any great burden of debt. It is evident, and I am glad it is so, that the farmers of Illinois are not complaining of the credits they are getting.

Where are the farmers who are complaining? My own conviction is, if any farmers anywhere are complaining about the lack of credit, it is the shiftless and inefficient farmer who is not entitled to very much credit from the banks or the government, or any one else.

The President suggested, just now, that we ought to find some way of furnishing credit to the man of small means, who has very little money, but still has a desire to own a farm. That is a case, of course, that the ordinary commercial bank could not meet under present conditions.

My friend, Mr. Johnson, here, and I were familiar with conditions in South Dakota some thirty years ago, when the government gave land away to the homesteaders. A young man would go out there and settle on land as a homesteader, get his land for nothing, and there were banks out there in those days who would loan him money to buy farming implements and seed and to work the farm, and would charge him two or three per cent a month, and they used to take a chattel mortgage that covered not only his growing crops, but all the crops that might be grown on the land for three or four years hence, and used to take a chattel mortgage on his cattle and on any increase that might come for two or three years in advance. That kind of banking was subjected to pretty severe criticism, but there are thousands of men in this country today who got their start, thousands of men who are rich or are in high places, got their start on just that kind of loans. Of course as the states got more settled and prosperous they passed usury laws to abolish that kind of banking. I suppose the usury laws are a necessity, but my own observation has been that they have done very little to defend the weak and helpless against the rapacity of the money shark, and on the other hand they have done a great deal to take away the chances of the ambitious and competent fellow who has very little money.

Now, if there is any excuse at all—and I don't think there is any—for the government sending these commissioners to Europe to study the land banking system over there, it is to help that class of people and there is no necessity of it.

We have an institution in this country that builds houses for the people of this country and it has been extensively used. That is the Building & Loan Association. It is beginning to be recognized as being applicable to farm lands. It is being used now quite extensively in Ohio. It is being tried out there, as I understand, and about five hundred such associations have grown up so far in Ohio and in the last year they loaned eleven million dollars. I take it those concerns are financed largely by the farmers, and that is the way they ought to be financed.

There are more farmers in this country today who are seeking some method of investing their money than there are farmers who are seeking loans, and as President Abbott, has said, it is a curious fact, and very strange to me, that the farmer never wants to invest in anything but land. There seems to be just two ways in which the ordinary farmer will use his money, either put it in the bank and have it lay there year after year, drawing three per cent interest, or whatever interest he can get for it, or else he will buy more land with it. Now, I can see no reason why the farmers in this country should not invest their surplus funds the same as other people invest, and that is, invest it in good stocks and bonds. There is a great field there.

As I said in the beginning Mr. Grout's speech made me feel there was no necessity for me to say anything. He said exactly what I wanted to say, but I didn't think he would. I came here with the idea that the farmer of this country doesn't need any government assistance, and I am delighted to find that you agree with me.

Gentlemen, I thank you. (Applause.)

President Abbott.—Mr. James Keeley, a prominent and successful farmer of DuPage County, devotes his leisure hours at night in being the general manager of the "World's Greatest Newspaper." No agricultural gathering is complete without the presence of a representative of the press. We are doubly fortunate in having in Mr. Keeley, not only a farmer, but a newspaper man as well. His subject is "Up State Versus Down State." I don't know which horn of this dilemma he is prejudiced either for or against, but as a down state farmer on one hand and an up state business man on the other, he can qualify in either class. I now introduce Mr. Keeley.

UP STATE VERSUS DOWN STATE

JAMES KEELEY, General Manager, Chicago Tribune, Chicago, Illinois

MR. CHAIRMAN AND GENTLEMEN: Will somebody please give me the location of the line that divides up State from down State?

Mr. Bartholomew.—Peoria. (Laughter.)

Mr. Keeley (continuing).—No, but actually where is the line? I have heard of the up-state and the down-state for twenty-two years. What is the dividing line? The boundary line of Cook County? Isn't that it, gentlemen?

Chairman Abbott.—Yes.

Mr. Keeley.—That word "versus" to my mind is used geographically, and I believe has led to more trouble in the State of Illinois than any other word in the English language. If I had the power to draw a bill I would draw one prohibiting the use of that word in connection with any part of the State of Illinois. I would introduce that bill in the Legislature, I would pass it, I would enact it, and then I would suggest as punishment for a

violation of that bill some mild punishment—something like burning in oil, or another more drastic than that.

The sooner we all realize that we, all of us, live in a state, and not any sectional part of a state, the better it will be for all of us.

We in the up part of the State cannot get along without you gentlemen from the down part of the State, neither can you get along without us. Why should the residents of a state be engaged in an eternal clothes-line fight, for that is all it is. What good does it do, except keep alive an intensive sectional feeling? The Mason and Dixon line is disappearing, the bloody shirt has been sent to the laundry, and the blue and the gray fraternize on the same battlefield, and the whole country is now being ruled by a man of southern birth. What is possible in a nation should be possible in a state.

This up state and down state feeling has largely been kept alive by politicians, and the average political issue of this character, nine times out of ten, conceals a personal issue, or rather a personal prejudice of the man advocating it. There is a Nigger in the wood pile all the while. I know from over twenty years residence in the northern part of the State that horn and tails are not worn very extensively up here, and I have never heard of any even as far down as Egypt. Fortunately, for all of us, I believe these antagonisms are disappearing.

Within the last two months there has been a recrudescence of the movement for a constitutional convention. The movement originated in Chicago and I am very happy to say that a number of the country newspapers have stated that the question is one not affecting Chicago alone, as has been argued in the past, but one in which the whole State is interested. A few years ago an utterance of this kind from down the State would have led to the denunciation of its author as a traitor to that part of the State. This shows we are progressing; that we are getting together.

Another development of recent years, which I believe is having, has had, and will have a marked effect in the amalgamation of the down State and the up stater is the "good roads" movement. That is the one thing most generally referred to tonight, and I take it from that it is one of the most vital things in the State at the present time.

We have, I am told, over 95,000 miles of roads in the State of Illinois, and you know better than I how many thousands of those roads are a handicap on a civilized community. Ten per cent of our roads only are improved in a permanent manner, as against 38 per cent in Indiana, 20 per cent in Wisconsin, with its enormous area in lakes and woodland, 20 per cent in Kentucky, with its large percentage of mountains, 28 per cent in Iowa, 25 per cent in Ohio, and 50 per cent in Massachusetts. Experts tell us that Illinois, as considered from the standpoint of improved roads, is twenty-fourth in the list of states, almost one-half way down. It is claimed that in some of the counties in the State of Illinois the highways are impassable for ordinary loads for fully one-third of the year. Bad roads not only hinder crop production and marketing, but they keep the rural consumer away from the store of the merchant for weeks at a time, they keep pupils from the school, and quite frequently voters from participating in election, and they impair the efficiency of the church, civil, fraternal and other organizations.

I am told over \$7,000,000 a year has been expended upon our highways. Probably we are a little better off than Iowa, in which over one hundred and ten millions of dollars was spent on roads before Iowa had a decent road in the state. Iowa didn't wake up until Lafe Young worked upon the farmers from river to river, and gave them an object lesson that started them thinking, and the result of that was apparent last year in the action taken by the Iowa legislature.

Experts say that over 35 per cent of the seven million dollars expended in our road building in the State of Illinois annually is wasted. Fortunately for all of us, I believe, with the action of the last session of the Legislature we have put an end to the system of road building and construction that has been complex, wasteful and inefficient. We are starting to climb out of our disgraceful position in the galaxy of states so far as roads are concerned. It will take us some time to go from the twenty-fourth position to a position befitting the standing of Illinois as a State.

As we get better roads, we of the up State will get to know you of the down State more intimately, and with intimacy will come a better understanding of each other's needs, and of each other's point of view. Strangers can and do do business together, but personal knowledge, friendship and complete understanding are assets, and not only of value in business but in every other human relationship. When we know each other thoroughly then there will be no imaginary line drawn somewhere south of Cook County, and up State versus down State will no longer be available as a dinner topic except as a key note for a recital of the friendly rivalry as to which section of the State, as a whole, is doing the most good for the State as a whole. Gentlemen, I thank you. (Applause.)

President Abbott.—One of the proper provinces of the Institute is to discuss the breeding and care of horses, so necessary for motive power; for the same reason we have speakers who discuss the gasoline engine and its troubles, and there are one or more gas engines on nearly every farm. The price of gasoline goes from a high to a higher standpoint and its use for some purposes becomes prohibitive. Motive power on the farm is a problem of great importance.

In the cities electricity for power has come into general use, but not so on the farm. There is a gentleman here who had a dream that some day the companies with which he is associated would furnish light and power to every farm in the State, and sometimes dreams come true. The coal I use costs me \$5.50 per ton, while the coal he uses costs him \$1.25 per ton. We sometimes have trouble in starting the gas engine, while the turning of a button will start the electric motor.

We will be interested in hearing what Mr. Samuel Insull, President of the Commonwealth Edison Company, has to say about the use of electricity on the farm. Mr. Insull is a most successful breeder and exhibitor of horses and preferred to be recognized, on this occasion, as a farmer rather than as an electrical expert, but as we were short on professional men, we held him to his electrical subject.

I have just learned that Mr. Insull has received a telegram advising him of serious illness in his family and requiring his presence at home. We certainly will excuse him and call upon Mr. W. L. Abbott, his Chief Operating Engineer to make a few remarks.

ELECTRICITY FOR THE FARM

W. L. ABBOTT, Chief Operating Engineer, Commonwealth Edison Company, Chicago, Illinois

MR. PRESIDENT AND GENTLEMEN: It is indeed embarrassing to attempt to fill the place of a great man, especially on such a short notice, but if I might be pardoned for digressing from the general theme of the evening for a moment, I will say a few words about the man in whose place I am speaking.

Mr. Samuel Insull, born in England some fifty-five years ago, came to this country when a young man and became associated with Mr. Thomas Edison, who was just then beginning his great career as an inventor. Only those who are intimately acquainted with Mr. Insull and Mr. Edison know to what extent the success of the latter was due to the business acumen of the former.

It was largely due to Mr. Insull's business ability, co-operating with Mr. Edison's inventive genius, that the Edison Electric Manufacturing Company was established and became such a marked success. After the enterprise was well under way Mr. Insull came west, about twenty years ago,

and took charge of what was then the Chicago Edison Company. Since Mr. Insull became president of the company its business has increased with such phenomenal rapidity that now the output of electrical energy from its various power-houses is one hundred times as great as it was when he first took hold of it. This is due not only to his complete command of all phases of the electrical business, but to his ability to convince the public that it is getting a square deal.

Of recent years Mr. Insull has applied himself to acquiring and consolidating various electric lighting properties of this and neighboring states, and I venture to say that as his success with the original Edison Manufacturing Company was outdone by his later success with the Commonwealth Edison Company, so will it in turn be outdone by the success which I confidently believe he will achieve in consolidating and upbuilding these scattered interests, and this is what interests this meeting tonight.

Attention was called at the beginning of the meeting to a condition which existed some thirty or forty years ago, wherein the milk wagons of three creameries daily passed the same houses in a community of farmers, the farmers themselves being obliged to pay the additional cost of the competition. Where three electric light companies have their poles and wires on a single street or on a single road, the farmers and others whose premises those wires pass are paying in the same way for that extra equipment and for that extra service. Competition is very good in theory and sometimes is effective, but it is no more effective in the case of competing electric light companies than it is in the case of the competing creameries.

I have a brother living in Mexico, who recently told me of some of the social conditions in that unhappy country. The principal occupation of the women appeared to be grinding corn with a mortar and pestal. The women had a steady job at what was considered to be woman's work. Later there were introduced into the communities gasoline engines for grinding corn, one of which engines could grind as much corn as a hundred families would eat. This innovation, instead of being held as a great boon to the country, was very greatly deplored by some who favored the old order of things and said that these women, now relieved of their steady jobs would have nothing to keep them busy at home as they should be, and they would now spend their time in idle gossip and mischief making. I do not know that the recent disturbance in Mexico is due in any measure to the introduction of these gasoline engines, but any people relieved from the drudgery of grinding toil is apt to begin to think of other liberties.

Some can remember years ago, before tallow candles were in common use in the farm-house, how they would fix up a little piece of cotton cloth in a saucer of oil or grease, which when lighted would give light throughout all the house, and plenty of it. Later on they made tallow dips, which were much better, and then tallow candles, which were good enough for anyone, and finally kerosene lamps, which made the house as light as day. Later on the common kerosene burner was succeeded by the Argand burner, and finally that by the acetylene gas plant; and at each stage of this development most people doubtless thought that they had something which was good enough, but as "time makes ancient good uncouth" and as each illuminant in turn became unsatisfactory and insufficient as soon as a better one appeared, so this process of dissatisfaction, improvement, and change will go on forever, let us hope.

What is the demand for electricity on the farm, anyway? That is a question which we can all answer in some way and to some extent, pumping, grinding, churning, etc., but the real use for electricity on the farm has not yet been developed, and I don't think it will be until we get electricity on the farm, and then you yourselves will find its real uses. The gasoline engine in Mexico was a senseless extravagance until it came, but now no revolution will be able to remove it.

You will not use electricity freely on the farm until you have it cheap—cheaper than any other available motive power, and you will not get electricity cheap so long as you will be able to buy it from two or more competing companies. Electricity can only be cheap when it is used to run the

grist-mill and the saw-mill in the country and the printing press and factory in the town, and also, if I might be pardoned for suggesting it, I will include the railroad, certainly the interurban.

When that time comes, and it is not so remote as most people think, you will have electricity so cheap that you can no longer afford to run a wind-mill, and available at your call day and night, in summer and winter. What revolution it will make in rural life we can better speculate upon when we consider that the height to which any people, community, or nation rises in the scale of civilization is indicated by the extent to which it uses power. (Applause.)

President Abbott.—As I look around the room I am impressed with the fact that the farmers have greater staying capacity than the representatives of the corporate interests. I don't know whether they are under the table or where they are gone. However, I will apologize to each and all of you for the length of the program tonight. I have enjoyed it thoroughly; it has not been tiresome to me. I want to thank our guests again for their presence here tonight and the way they have contributed to make this evening so enjoyable. I think, on the whole, we can well congratulate ourselves that the evening has passed so harmonious and so peaceful. I know we all feel that we understand each other better than we did before we came. I believe we all want to co-operate in every practicable and possible way for development not only agriculturally but keeping in mind the human factor of what is the greatest good for the greatest people. I thank you all. (Applause.)

